

## SECTION 02070

## SELECTIVE DEMOLITION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section requires the selective removal and subsequent offsite disposal of the following:
  - 1. Portions of existing building indicated on drawings and as required to accommodate new construction.
  - 2. Removal of interior partitions as indicated on drawings.
  - 3. Removal of doors and frames indicated "to be removed."
  - 4. Removal of built-in casework indicated "to be removed."
  - 5. Removal and protection of existing fixtures, materials, and equipment items indicated to be removed, salvaged, relocated, reinstalled, etc.
- B. Removal work specified elsewhere:
  - 1. Roofing and roof insulation removal is specified in Division 7.
  - 2. Cutting nonstructural concrete floors and masonry walls for piping, ducts, and conduits is included with the work of the respective mechanical and electrical specification sections in Divisions 15 and 16.
  - 3. Cutting holes in roof deck for installation of new rooftop mechanical equipment is specified in Division 15.
  - 4. Relocation and rewording of existing facility sign is specified in Section 10425, "Signs".
- C. Related work specified elsewhere:

1. Remodeling construction work and patching are included within the respective sections of specifications, including removal of materials for reuse and incorporation into remodeling or new construction.
2. Relocation of pipes, conduits, ducts, and other mechanical and electrical work is specified in other Divisions.

### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Schedule indicating proposed sequence of operations for selective demolition work to Contracting Officer for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.
  1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Government's on-site operations.
  2. Coordinate with Government's continuing occupation of portions of existing building and with Government's partial occupancy of completed remodeled areas.
- C. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Contracting Officer prior to start of work.

### 1.4 JOB CONDITIONS

- A. Occupancy: Government will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in such a manner that will minimize need for disruption of Government's normal operations. Provide minimum of 72 hours advance notice to Government of demolition activities that will affect Government's normal operations.
- B. Condition of Structures: Government assumes no responsibility for actual condition of items or structures to be demolished. Conditions existing at time of Contractor's inspection for bidding purposes will be maintained by Government insofar as practicable. However, minor variations within structure may occur by Government's removal and salvage operations prior to start of selective demolition work.
- C. Partial Demolition and Removal: Items indicated to be removed but of salvageable

value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed. Storage or sale of removed items on site will not be permitted.

- D. Protections: Provide temporary barricades and other forms of protection to protect Government's personnel and general public from injury due to selective demolition work.
  - 1. Provide protective measures as necessary and required to provide free and safe passage of Government's personnel and general public to any occupied portions of building.
  - 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
  - 3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
  - 4. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.
  - 5. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
  - 6. Remove protections at completion of work.
- E. Damages: Promptly repair damages caused to adjacent facilities by demolition work.
- F. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- G. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.
- H. Utility Services: Maintain existing utilities indicated to remain in service and

protect them against damage during demolition operations.

1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
  2. Maintain fire protection services during selective demolition operations.
- I. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing and/or approved regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 PREPARATION

General: Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.

- A. Cease operations and notify Contracting Officer immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.
- B. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to any occupied portions of the building.
  1. Where selective demolition occurs immediately adjacent to any occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with sound-deadening insulation as required by Contracting Officer.
  2. Provide weatherproof closures for exterior openings resulting from demolition work.
- C. Locate, identify, stub off, and disconnect utility services that are not indicated to remain. Provide bypass connections as necessary to maintain continuity of service to any occupied areas of building. Provide minimum of 72 hours advance notice to Contracting Officer if shutdown of service is necessary during changeover.

### 3.2 DEMOLITION

- A. General: Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.
  - 1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
  - 2. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.
  - 3. Provide services for effective air and water pollution controls as required.
  - 4. Demolish foundation walls to a depth of not less than 12 inches below existing ground surface. Demolish and remove below-grade wood or metal construction. Break up below-grade concrete slabs.
  - 5. For interior slabs on grade, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible.
  - 6. Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter.
- B. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Contracting Officer in written accurate detail. Pending receipt of directive from Contracting Officer, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

### 3.3 SALVAGED MATERIALS

- A. Salvaged Items: Where indicated on Drawings as "Salvage - Deliver to Government," carefully remove indicated items, clean, store, and turn over to Government and obtain a receipt.
- B. Historic artifacts, including cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historic significance, remain

property of Government. Notify Contracting Officer if such items are encountered and obtain acceptance regarding method of removal and salvage for Government.

### 3.4 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove debris, rubbish, and other materials resulting from demolition operations from building site. Transport and legally dispose off Base.
- B. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
- C. Burning of removed materials is not permitted on Project site or the Base.

### 3.5 CLEANUP AND REPAIR

General: Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 02070

## SECTION 02110

## SITE CLEARING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

This Section includes the following:

- A. Removal of trees and other vegetation.
- B. Topsoil stripping.
- C. Clearing and grubbing.
- D. Removing above-grade improvements.
- E. Removing below-grade improvements.

## 1.3 PROJECT CONDITIONS

- A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protection necessary to prevent damage to existing improvements indicated to remain in place.
  - 1. Protect improvements on adjoining properties and on Government's property.
  - 2. Restore damaged improvements to their original condition, as acceptable to Contracting Officer.
- C. Protection of Vegetation: Protect vegetation indicated to remain in place against unnecessary damage by stockpiling construction materials or excavated materials, excess foot or vehicular traffic, or parking of vehicles. Provide temporary guards to protect vegetation to be left.

## 1.4 EXISTING SERVICES

- A. General: Indicated locations are approximate; determine exact locations before commencing Work.
- B. Arrange and pay for disconnecting, removing, capping, and plugging utility services. Notify Contracting Officer in advance and obtain approval before starting this Work.
- C. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
- B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.
  - 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
  - 2. Stockpile topsoil in storage piles in areas directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion.
  - 3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material.
- C. Clearing and Grubbing: Clear site of indicated trees, shrubs, and other vegetation.
  - 1. Completely remove stumps, roots, and other debris protruding through



ground surface.

2. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.

D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.

E. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 15 and 16 Sections. Removing abandoned underground piping or conduits interfering with construction are included under this Section.

### 3.2 DISPOSAL OF WASTE MATERIALS

A. Burning on Government Property: Burning is not permitted on Government property.

B. Removal from Government Property: Remove waste materials and unsuitable or excess topsoil from Government property.

END OF SECTION 02110

## SECTION 02200

## EARTHWORK

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

A. This Section includes the following:

1. Preparing and grading subgrades for slabs-on-grade, walks, pavements, and landscaping.
2. Excavating and backfilling for buildings and structures.
3. Drainage and moisture-control fill course for slabs-on-grade.
4. Subbase course for walks and pavements.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling trenches within building lines.
7. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Division 2 Section "Site Clearing" for site stripping, grubbing, topsoil removal, and tree removal.
2. Division 2 Section "Landscape Work" for finish grading, including placing and preparing topsoil for lawns and planting.
3. Division 3 Section "Cast-In-Place Concrete" for concrete encasings, cradles, and appurtenances for utility systems.

### 1.3 DEFINITIONS

- A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- D. Subbase Course: The layer placed between the subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or walk.
- E. Base Course: The layer placed between the subbase and surface pavement in a paving system.
- F. Drainage Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water.
- G. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Contracting Officer. Unauthorized excavation, as well as remedial work directed by the Contracting Officer, shall be at the Contractor's expense.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- I. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services.
- J. Select Fill: Course of low plasticity, essentially nonvolume change material.

### 1.4 SUBMITTALS

General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

- A. Product data for the each type of plastic warning tape.
- B. Test Reports: In addition to test reports required under field quality control, submit the following:

1. Laboratory analysis of each soil material proposed for select fill and backfill from on-site and borrow sources.
2. One optimum moisture-maximum density curve for each soil material.
3. Report of actual unconfined compressive strength and/or results of bearing tests of each stratum tested.

## 1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Explosive materials are not permitted on the premises.
- C. Testing and Inspection Service: Employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Before commencing earthwork, meet with representatives of the governing authorities, Contracting Officer, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

## 1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Government or others except when permitted in writing by the Contracting Officer and then only after acceptable temporary utility services have been provided. Provide a minimum 72-hours' notice to the Contracting Officer and receive written notice to proceed before interrupting any utility.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with Contracting Officer to shutoff services if lines are active.

## PART 2 - PRODUCTS

## 2.1 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials.
- E. Subbase and Base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, ASTM D 2940, with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Subbase or base materials.
- G. Bedding Material: Subbase or base materials with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate grading size 57, with 100 percent passing a 1-1/2-inch sieve and not more than 5 percent passing a No. 8 sieve.
- I. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 50 sieve.
- J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

## 2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide

and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, and detectable by metal detector when tape is buried up to 2'-6" deep.

1. Tape Colors: Provide tape colors to utilities as follows:
  - a. Red: Electric.
  - b. Yellow: Gas, oil, steam, and dangerous materials.
  - c. Orange: Telephone and other communications.
  - d. Blue: Water systems.
  - e. Green: Sewer systems.
2. On all water, irrigation and gas line supply and install 10 AWG tracer wire, unsplined, wrap around the utility, and extend from the source of supply to the point of termination at the facility.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.2 DEWATERING

- A. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

### 3.3 EXCAVATION

- A. Explosives: Do not use explosives.

- B. Unclassified Excavation: Includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.
- C. Classified Excavation: Includes excavation to required subgrade elevations. Excavation will be classified as earth excavation or rock excavation as follows:
  - 1. Earth excavation includes excavation of pavements and other obstructions visible on surface, underground structures, utilities, and other items indicated to be demolished and removed together with soil and other materials encountered that are not classified as rock or unauthorized excavation. Intermittent drilling or ripping to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
  - 2. Rock excavation includes removal and disposal of rock material and obstructions encountered that cannot be removed by heavy-duty rock excavating equipment without systematic drilling or ripping. Rock material includes boulders 1/2 cu. yd. or more in volume and rock in beds, ledges, unstratified masses, and conglomerate deposits.

### 3.4 STABILITY OF EXCAVATIONS

Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

### 3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.
- B. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
- C. Pile Foundations: Stop excavations from 6 inches to 12 inches above bottom of footing before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
- D. Excavation for Underground Mechanical or Electrical Appurtenances: Excavate to elevations and dimensions required within a tolerance of plus or minus 0.10 foot.

Do not disturb bottom of excavations intended for bearing surface.

### 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

Excavate surfaces under walks and pavements to required cross sections, elevations, and grades.

### 3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to required slopes, lines, depths, and invert elevations. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated. Clearance: 12 inches each side of pipe or conduit or as required.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.
  - 1. For pipes or conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
  - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
  - 3. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

### 3.8 APPROVAL OF SUBGRADE

- A. Notify the Contracting Officer when excavations have reached required subgrade.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities as directed by the Contracting Officer.
- C. When the Contracting Officer determines that unforeseen unsatisfactory material is present, continue excavation and replace with compacted backfill or fill material



as directed. Unforeseen additional excavation and replacement of unsatisfactory material will be paid according to the Contract provisions. Unforeseen unsatisfactory material does not include subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities

### 3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending required bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Contracting Officer. Fill unauthorized excavations under other construction as directed by the Contracting Officer.
- B. Where required widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Contracting Officer.

### 3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust. Stockpile soil materials away from edge of excavations.
- B. Any excavated material stockpiled for borrow material that becomes contaminated with unsatisfactory material shall be removed and disposed of off Base.

### 3.11 BACKFILL

Backfill excavations promptly, but not before completing the following:

- A. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
- B. Surveying locations of underground utilities for record documents.
- C. Testing, inspecting, and approval of underground utilities.
- D. Concrete formwork removal.
- E. Removal of trash and debris from excavation.
- F. Removal of temporary shoring and bracing, and sheeting.

### 3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings.
- C. Provide 4-inch-thick concrete base slab support for piping or conduit less than 2'-6" below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- D. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- E. Coordinate backfilling with utilities testing.
- F. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- G. Place and compact final backfill of satisfactory soil material to final subgrade.
- H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
- B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.
- C. Place fill material in layers to required elevations for each location listed below.

1. Under grass, use satisfactory excavated or borrow soil material.
2. Under walks and pavements, use subbase or base material, or satisfactory excavated or borrow soil material.
3. Under building slabs, use drainage fill and select fill material.
4. Under footings and foundations, use engineered fill.

### 3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
  1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
  2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
  3. Stockpile or spread and dry removed wet satisfactory soil material.

### 3.15 COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
- C. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557:
  1. Under structures, building slabs and pavements, compact the top 12 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
  2. Under walkways, compact the top 6 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
  3. Under lawn or unpaved areas, compact the top 6 inches below subgrade and each layer of backfill or fill material at 90 percent maximum dry density.

### 3.16 GRADING

- A. General: Unless otherwise indicated, uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations required.
  - 1. Provide a smooth transition between existing adjacent grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  - 1. Lawn or Unpaved Areas: Plus or minus 0.10 foot.
  - 2. Walks: Plus or minus 0.10 foot.
  - 3. Pavements: Plus or minus 1/2 inch.
- C. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

### 3.17 SUBBASE AND BASE COURSES

Under pavements and walks, place subbase course material on prepared subgrades. Place base course material over subbases to pavements.

- A. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent of ASTM D 4254 relative density.
- B. Shape subbase and base to required crown elevations and cross-slope grades.
- C. When thickness of compacted subbase or base course is 6 inches or less, place materials in a single layer.
- D. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

### 3.18 DRAINAGE FILL

Under slabs-on-grade, place drainage fill course on prepared subgrade. Compact drainage fill to required cross sections and thickness. When compacted thickness of drainage fill is 6 inches or less, place materials in a single layer.

### 3.19 FIELD QUALITY CONTROL

- A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.
    - a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.
    - b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Contracting Officer.
  2. Footing Subgrade: At footing subgrades, perform at least one test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of each subgrade with related tested strata when acceptable to the Contracting Officer.
  3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
  4. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
  5. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.

- B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

### 3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions. Scarify or remove and replace material to depth directed by the Contracting Officer; reshape and recompact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project warranty period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

### 3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Government property.

END OF SECTION 02200

## SECTION 02282

## TERMITE CONTROL

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

This Section includes soil treatment for termite control.

## 1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product data and application instructions.
- C. Certification that products used comply with U.S. Environmental Protection Agency (EPA) regulations for termiticides.

## 1.4 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for preparing substrate and application.
- B. Engage a professional pest control operator who is licensed according to regulations of governing authorities to apply soil treatment solution.
- C. Use only termiticides that bear a federal registration number of the EPA and are approved by authorities having jurisdiction.

## 1.5 JOB CONDITIONS

- A. Restrictions: Do not apply soil treatment solution until excavating, filling, and grading operations are completed, except as otherwise required in construction operations.

- B. To ensure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.

## 1.6 WARRANTY

- A. Warranty: Furnish written warranty, executed by Applicator and Contractor, certifying that applied soil termiticide treatment will prevent infestation of subterranean termites. If subterranean termite activity is discovered during warranty period, Contractor will re-treat soil and repair or replace damage caused by termite infestation.
- B. Warranty Period: 5 years from date of Substantial Completion.
- C. The warranty shall not deprive the Government of other rights the Government may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

## PART 2 - PRODUCTS

### 2.1 SOIL TREATMENT SOLUTION

- A. General: Use an emulsible, concentrated termiticide that dilutes with water, specially formulated to prevent termites infestation. Fuel oil will not be permitted as a diluent. Provide a solution consisting of one of following chemical elements. Shall contain synthetic dye to permit visual identification of treated soil, of the generic chemical.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
  - 1. Chloropyrifos:  
Dursban TC, Dow Chemical Co.
  - 2. Permethrin:
    - a. Dragnet FT, FMC Corp.
    - b. Torpedo, ICI Americas, Inc.
  - 3. Cypermethrine:
    - a. Prevail FT, FMC Corp.
    - b. Demon, ICI Americas, Inc.
  - 4. Fenvalerate:  
Gold Coast Tribute, Du Pont.



5. Isofenphose:  
Pryfon, Mobay Corp.
- C. Dilute with water to concentration level recommended by manufacturer.
- D. Other solutions may be used as recommended by Applicator if approved for intended application by Contracting Officer. Use only soil treatment solutions that are not harmful to plants.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Surface Preparation: Remove foreign matter that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicants may be applied before placing compacted fill under slabs if recommended by toxicant manufacturer.
- B. Application Rates: Apply soil treatment solution as follows:
  1. Under slab-on-grade structures, treat soil before concrete slabs are placed, using the following application rates:
    - a. Apply 4 gallons of chemical solution per 10 linear feet to soil in critical areas under slab, including entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers.
    - b. Apply 1 gallon of chemical solution per 10 sq. ft. as an overall treatment under slab and attached slab areas where fill is soil or unwashed gravel. Apply 1-1/2 gallons of chemical solution to areas where fill is washed gravel or other coarse absorbent material.
    - c. Apply 4 gallons of chemical solution per 10 linear feet of trench for each foot of depth from grade to footing, along outside edge of building. Dig a trench 6 to 8 inches wide along outside of foundation to a depth of not less than 12 inches. Punch holes to top of footing at not more than 12 inches o.c. and apply chemical solution. Mix chemical solution with the soil as it is being replaced in the trench.
  2. At control joints, and areas where slabs will be penetrated, apply at rate of 4 gallons per 10 linear feet of penetration.
- C. Post signs in areas of application to warn workers that soil termiticide treatment has been applied. Remove signs after areas are covered by other construction.

- D. Reapply soil treatment solution to areas disturbed by subsequent excavation, landscape grading, or other construction activities following application.

END OF SECTION 02282

## SECTION 02380

## CAISSONS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes drilled, cast-in-place reinforced concrete end-bearing caissons.
- B. Extent of caissons is shown on drawings, including locations, diameters of shafts, estimated bottom elevations, top elevations, and details of construction.

## 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Concrete Materials Test Reports as proposed for use in concrete mixes.
- C. Certified Caisson Report for each caisson, recording actual elevation at bottom and top, elevation of rock (if any), final centerline location at top, variation of shaft from plumb, depth of socket (if applicable), seepage of water, any unusual conditions.
- D. Concrete Design Mix Reports listing mixes required and their respective test results.
- E. Concrete Test Reports, recording pertinent information and certification of compliance with Project requirements.

## 1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of American Concrete Institute ACI 336.1 "Standard Specification for the Construction of End Bearing Drilled Piers," and as herein specified.
- B. Where provisions of above standard conflict with building regulations in effect for this Project, building regulations will govern, but only to establish minimum

requirements.

- C. Caisson Installer Qualifications: Not less than three successfully completed contracts with similar soil conditions, shaft sizes, depths, and volumes of Work contained in this Project.
- D. Survey Work: Engage a registered surveyor or licensed professional engineer to perform surveys, layouts, and measurements for caisson work. Conduct layout work for each caisson to lines and levels required before excavation, and actual measurements of each caisson's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other data as required.
- E. Concrete Testing Service: Employ testing laboratory to perform material evaluation tests and to design concrete mixes.
- F. Materials and installed work may require testing and retesting at any time during progress of Work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Government's expense, including retesting of rejected materials and installed work, are Contractor's responsibility.
- G. Certificates of material properties, indicating, compliance with specified requirements, may be submitted in lieu of testing when acceptable to Contracting Officer. Certificates of compliance must be signed by materials producer and Contractor.

## 1.5 JOB CONDITIONS

- A. Site Information: Data on indicated subsurface conditions is not intended as representations or warranties of continuity of such conditions. It is expressly understood that Government will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor and are not guaranteed to represent conditions that may be encountered.
- B. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to Government.
- C. Existing Utilities: Locate existing underground utilities before starting caisson excavation operations. If utilities are to remain in place, provide protection from damage during caisson operations.
- D. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Contracting Officer immediately for directions as to procedure. Cooperate with Government and utility companies in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

- E. Do not interrupt existing utilities except when permitted in writing by Contracting Officer and Base Civil Engineer and after acceptable temporary utility services have been provided.

## PART 2 - PRODUCTS

### 2.1 CONCRETE AND RELATED MATERIALS

- A. Concrete and related materials are specified in Division 3 Sections.
- B. Portland Cement: ASTM C 150, Type I.
- C. Fly Ash: ASTM C 618, Type F.
- D. Aggregates: ASTM C 33, and as herein specified.
  - 1. Local aggregates not complying with ASTM C 33, but which have shown by test or actual service to produce concrete of adequate strength and durability, may be used when acceptable to Contracting Officer.
  - 2. Maximum Aggregate Size: Not larger than three-fourths of minimum clear spacing between individual reinforcing bars or bundles of bars.
- E. Water: Drinkable.
- F. Air-Entraining Admixture: ASTM C 260.
- G. Water-Reducing Admixture: ASTM C 494, Type A, containing no set-accelerating or set-retarding compounds, chlorides, fluorides, or nitrates.
- H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
- I. Reinforcing Bars and Dowels: ASTM A 615, Grade 60.

### 2.2 CONCRETE MIX DESIGN

- A. General: Use independent testing facility for preparing and reporting proposed mix designs and placement methods. Testing facility shall not be same as used for field quality control testing.
- B. Design mix to produce concrete for caissons with minimum 28-day compressive strength of 3000 psi.
- C. Proportion mixes by either laboratory trial batch or field experience methods using

materials and placement methods to be employed on Project for each class of concrete required, complying with ACI 211.1.

- D. Submit written reports to Contracting Officer of proposed mix for concrete at least 15 days prior to start of work. Do not begin concrete production until mix design has been reviewed by Contracting Officer.
- E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant at no additional cost to Government and as accepted by Contracting Officer. Laboratory test data for revised mix design and strength results must be accepted by Contracting Officer before using in Work.
- F. Admixtures: Use air-entraining admixture in concrete, unless otherwise directed. Add air-entraining admixture at manufacturer's prescribed rate to ensure in concrete at point of placement having 4 percent to 6 percent air content.
- G. Use water-reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used at Contractor's option.
- H. Use amounts of admixtures as recommended by manufacturer for climatic conditions prevailing at time of placing concrete. Adjust quantities of admixtures as required to maintain quality control.
- I. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement of not less than 3 inches and not more than 5 inches.

## 2.3 CONCRETE MIXING

Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

- A. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to batch will not be permitted.
- B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.
- C. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 CAISSON EXCAVATION

- A. General: Excavate holes for caissons to required bearing strata or elevations shown on drawings. Excavate holes for closely spaced caissons, and those occurring in fragile or sand strata, only after adjacent holes are filled with concrete and allowed to set.
- B. The design of caissons is based on assumed strata bearing capacity. If bearing stratum is not capable of maintaining bearing capacity assumed, foundation system will be revised as directed by Contracting Officer. Revisions will be paid for in accordance with Contract conditions relative to changes in Work.
- C. If required, install casings as excavation proceeds so that earth walls are maintained without spilling into shaft.
- D. Construction Tolerances: Locate centerline of caissons within the following tolerances:
  - 1. Maximum permissible variation of location not more than 1/24th of shaft diameter or 3 inches, whichever is less.
  - 2. Shafts out of plumb not more than 1.5 percent of length nor exceeding 12.5 percent of shaft diameter or 15 percent, whichever is less.
  - 3. Concrete cut-off elevation, plus 1 inch to minus 3 inches.
- E. If above tolerances are exceeded, provide corrective construction to compensate for excessive eccentricity. Submit proposed corrective construction methods to Contracting Officer for review before proceeding.
- F. Temporary Shaft Protections: When required, provide full-length watertight steel casings of sufficient thickness to withstand compressive, displacement, and withdrawal stresses and to maintain shaft walls. Temporary casings may be left in place or may be withdrawn as concrete is placed at Contractor's option.
- G. Obstructions: If rock, boulders, or other unforeseen obstructions are encountered which cannot be removed by standard caisson excavation methods, and if such obstructions are not indicated by available subsurface data, removal of such obstructions will be paid for in accordance with terms of Contract relative to changes in Work.
- H. Remove such obstructions by hand labor using air-powered tools or by other methods recognized in construction industry.
- I. Classification of Rock: Rock is defined as material which cannot be drilled with a conventional earth auger or underreaming tool, and requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation. Earth

seams, rock fragments, and voids included in rock excavation area will be considered rock for full volume of shaft from initial contact with rock for pay purposes.

- J. The work of this Section includes demolition and removal of rock boulders, concrete, masonry, and other subsurface obstructions which are clearly indicated by Contract Documents, or by available subsurface exploration data, and is not considered a change in Work.
- K. Dewatering: Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult with Contracting Officer before using alternate methods of construction.
- L. Conduct water to general site run-off ditches and disposal areas with discharge lines. Provide ditching as required to conduct water to site drainage facilities.
- M. Inspection: Each caisson must be inspected and tested before placing concrete.
- N. Provide and maintain facilities with equipment required for inspection and testing of excavations. Cooperate with inspecting and testing personnel to expedite Work.
- O. Notify Contracting Officer and testing facility at least 6 hours prior to time excavations will be ready for inspection and tests.
- P. Depth of Bearing Stratum: If indicated depth of shaft excavation is reached without developing required stratum bearing capacity, immediately suspend excavation operations and inform Contracting Officer. Contracting Officer will determine procedures to be followed.
- Q. Where changes in indicated depth or dimensions are required, or additional soil borings are required, proceed with such work when directed in writing by Contracting Officer.
- R. Overexcavation: No payment will be made for extra length, when caisson shafts are excavated to a greater depth than required or authorized by Contracting Officer, due to overdrilling by Contractor. Complete caisson and fill extra depth with concrete if other conditions are satisfactory. Overexcavated shafts will be measured and paid for to original design or authorized depth.
- S. Excavated Material: Remove excavated material and legally dispose off site.

### 3.2 REINFORCING STEEL AND DOWELS

- A. Before placing, clean reinforcing steel and dowels of loose rust, scale, dirt, grease,



and other material which could reduce or destroy bond.

- B. Fabricate and erect reinforcing cages in shafts as one continuous unit using inner ring resteel. Place reinforcement accurately and symmetrically about axis of hole and hold securely in position during concrete placement.
- C. Use templates to set anchor bolts, leveling plates, and other accessories furnished under work of other sections. Provide blocking and holding devices to maintain required position during concrete placement.
- D. Protect exposed ends of extended reinforcing, dowels, or anchor bolts from mechanical damage and exposure to weather.

### 3.3 CONCRETE PLACEMENT

- A. General: Fill caissons with concrete immediately after inspection and approval by testing laboratory.
- B. Place concrete continuously and in a smooth flow without segregating. Provide mechanical vibration for consolidation of at least top 25 feet of each shaft.
- C. Place concrete by means of bottom discharge bucket, flexible drop chute, elephant trunk hopper, or tremie. Use chutes or tremies for placing concrete where a drop of more than 25 feet is required, or pump concrete into place.
- D. Place concrete in-the-dry unless placing under water is acceptable to Contracting Officer. If water occurs, and it is impracticable to dewater caisson excavation, and reasonable attempts to seal off water flow have failed, allow water level to attain its normal level and place concrete by tremie method. Control placement operations to ensure that tremie is not broken during continuous placing from bottom to top. Other methods of depositing concrete under water may be used, if acceptable to Contracting Officer.
- E. Maintain a sufficient head of concrete to prevent reduction in diameter of caisson shaft by earth pressure and to prevent extraneous material from mixing with fresh concrete. Coordinate withdrawal of temporary casings with concrete placement operations to maintain a head of concrete approximately 5 feet above casing bottom.
- F. Stop concrete placement at cut-off elevation shown, screed level, and apply a scoured, rough finish. Where cut-off elevation is above ground elevation, form top section above grade and extend shaft to required elevation.
- G. Interrupted placing operations of over one-hour duration will require a cold joint installation. Leave resulting shaft surface approximately level and insert steel dowels as shown on drawings. At resumption of concrete placing, clean off surface

laitance, roughen as required, and slush with a 1-to-1 cement grout or commercial bonding agent before remainder of concrete is placed.

- H. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures in compliance with ACI 306 and as herein specified.
- I. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C) uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
- J. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
- K. Do not use calcium chloride, salt, or other mineral containing antifreeze agents or chemical accelerators, unless accepted by Contracting Officer.
- L. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
- M. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control concrete temperature, provided water equivalent of ice is calculated into total amount of mixing water. Cooling concrete mixture by use of liquid nitrogen may be used if acceptable to Contracting Officer.
- N. Place concrete immediately upon delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means.
- O. Do not use retarding admixtures without acceptance of Contracting Officer.

### 3.4 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Sample and test concrete for quality control during placement as follows:
  - 1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
  - 2. Slump: ASTM C 143; one test for each concrete load at point of discharge, and one for each set of compressive strength test specimens.
  - 3. Air Content: ASTM C 231, pressure method; one test for each set of compressive strength test specimens.
  - 4. Compression Test Specimens: ASTM C 31; one set of four standard

- cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
5. Concrete Temperature: Test when air temperature is 40 deg F (4 deg C) and below, and when 80 deg F (27 deg C) and above, and each time a set of compression test specimens made.
  6. Compressive Strength Tests: ASTM C 39; one set of four cylinders per drilled pier but not more than one set per truck. One specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
  7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.
- B. Report test results, in writing to Contracting Officer and Architect on same day tests are made. Include in reports Project identification name and number, date of concrete placement, name of contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type, location of caisson, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength and type of break for both 7-day test and 28-day test.
- C. Additional Concrete Tests: Testing service may take core samples of in-place concrete when test results indicate such that there is reasonable doubt that specified concrete strengths have not been attained.
- D. Continuous coring of caissons may be required, at Contractor's expense, when time for removal of temporary casings exceeds specified limits, or where observations of placement operations indicate suspicion of quality of concrete, presence of voids, segregation, or other possible defects.
- E. Bottom elevations, and lengths of caissons as shown on drawings are estimated from available soil data. Actual elevations and caisson lengths, will be determined by soil testing facility from conditions found in excavations. Final evaluations and acceptance of data will be determined by Contracting Officer.

END OF SECTION 02380

## SECTION 02511

## HOT-MIXED ASPHALT PAVING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes provisions for hot-mixed asphalt paving over prepared subbase.
- B. Prepared subbase is specified in another Division 2 section.
- C. Proof rolling of prepared subbase is included in this Section.
- D. Saw-cutting of edges of existing pavement is specified in site-clearing section.
- E. Asphalt slurry seal is included in this section.

## 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.
- C. Pavement marking plan indicating lane separations and defined parking spaces. Note dedicated handicapped spaces with international graphics symbol.
- D. Test Reports: submit following reports directly from the test lab to the BCE, with copy to the General contractor:
  - Gradations
  - Marshall Specimens
  - Field Density and Thickness Cores
  - Asphalt Extraction
  - Smoothness Test

## 1.4 SITE CONDITIONS

- A. Weather Limitations: Apply prime and tack coats when ambient temperature is

above 50 deg F (10 deg C) and when temperature has not been below 35 deg F (1 deg C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

- B. Construct hot-mixed asphalt surface course when atmospheric temperature is above 40 deg F (4 deg C) and when base is dry. Base course may be placed when air temperature is above 30 deg F (minus 1 deg C) and rising.
- C. Grade Control: Establish and maintain required lines and elevations.

## QUALITY ASSURANCE

- A. Comply with the State highway or transportation department standard specifications, latest edition, and with local governing regulations if more stringent than specified.
- B. Testing and inspection services: Employ a certified testing laboratory to perform pavement design and inspection service for quality control testing during paving operations. Testing lab shall be acceptable to the terms in Division 1.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations.
- B. Coarse Aggregate: Sound, angular crushed stone, crushed gravel, or properly cured crushed blast furnace slag, complying with ASTM D 692-88.
- C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone, properly cured blast furnace slag, gravel, or combinations thereof, complying with ASTM D 1073.
- D. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242.
- E. Asphalt Cement: ASTM D 3381 for viscosity-graded material; ASTM D 946 for penetration-graded material.
- F. Prime Coat:
- G. Tack Coat: Emulsified asphalt; ASTM D 977.
- H. Lane Marking Paint: Alkyd-resin type, ready-mixed complying with AASHTO M 248, Type I.

Color: Yellow.

- I. Wheel Stops: 2,500-psi compressive strength precast, air-entrained concrete, approximately 6 inches high, 9 inches wide, and 7 feet long. Provide chamfered corners and drainage slots on underside.
- J. Herbicide Treatment: Commercial chemical for weed control, registered by the Environmental Protection Agency. Provide granular, liquid, or wettable powder form.

## 2.2 ASPHALT-AGGREGATE MIXTURE

Provide plant-mixed, hot-laid asphalt-aggregate mixture complying with ASTM D 3515 and as recommended by local paving authorities to suit project conditions.

## PART 3 - EXECUTION

### 3.1 SURFACE PREPARATION

- A. General: Remove loose material from compacted subbase surface immediately before applying prime coat.
- B. Proof-roll prepared subbase surface to check for unstable areas and areas requiring additional compaction.
- C. Notify Contractor of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.
- D. Prime Coat: Apply at rate of 0.20 to 0.50 gal. per sq. yd., over compacted subgrade. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.
- E. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface.
- F. Allow to dry until at proper condition to receive paving.
- G. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.
- H. Herbicide Treatment: Apply chemical weed control in strict compliance with the manufacturer's recommendations. Apply to compacted sub-base prior to placement of prime coat.

### 3.2 PLACING MIX

- A. General: Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. Spread mixture at minimum temperature of 225 deg F (107 deg C). Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.
- B. Paver Placing: Place in strips not less than 10 feet wide, unless otherwise acceptable to Contracting Officer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
- C. Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute.
- D. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.

### 3.3 ROLLING

- A. General: Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained 95 percent laboratory density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.4 TRAFFIC AND LANE MARKINGS

- A. Cleaning: Sweep and clean surface to eliminate loose material and dust.
- B. Striping: Use chlorinated-rubber base traffic lane-marking paint, factory-mixed, quick-drying, and nonbleeding.
- C. Do not apply traffic and lane marking paint until layout and placement have been verified with Contracting Officer.
- D. Apply paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 12 to 15 mils dry thickness.

### 3.5 WHEEL STOPS

General: Secure wheel stops to hot-mixed asphalt surface with not less than two 3/4-inch-diameter galvanized steel dowels embedded in precast concrete at 1/3 points. Size length of dowel to penetrate at least 1/2 hot-mixed asphalt depth.

### 3.6 FIELD QUALITY CONTROL

- A. General: Testing in-place hot-mixed asphalt courses for compliance with requirements for thickness and surface smoothness will be done an independent testing laboratory. Repair or remove and replace unacceptable paving as directed by Contracting Officer.
- B. Thickness: In-place compacted thickness tested in accordance with ASTM D 3549 will not be acceptable if exceeding following allowable variations:
  - 1. Base Course: Plus or minus 1/2 inch.
  - 2. Surface Course: Plus or minus 1/4 inch.
- C. Surface Smoothness: Test finished surface of each hot-mixed asphalt course for smoothness, using 10-foot straightedge applied parallel with and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:
  - 1. Base Course Surface: 1/4 inch.
  - 2. Wearing Course Surface: 3/16 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
- D. Check surface areas at intervals as directed by Contracting Officer.



1. Transport bituminous material from the mixing plant to the paving site in trucks having tight, clean, smooth beds that have been coated with a minimum amount of concentrated solution of hydrated lime and water or other approved coating to prevent adhesion of the mixture to the truck. Petroleum products will not be permitted for coating truck. If air temperature is less than  $16^{\circ}\text{C}$   $\sim 60^{\circ}\text{F}$  or if haul time is greater than 30 minutes, cover each load with canvas or other approved material of ample size to protect the mixture from the loss of heat. Make deliveries so that the spreading and rolling of all the mixture prepared for one day's run can be completed during daylight, unless adequate approved artificial lighting is provided. Deliver mixture to area to be paved so that the temperature at the time of dumping into the spreader is within the range specified herein. Reject loads that are below minimum temperature, that have crusts of cold unworkable material, or that have been wet excessively by rain. Hauling over freshly laid material is prohibited.
2. Shoveling, Raking, and Tamping After Machine-Spreading: Shovelers and rakers shall follow the spreading machine. Add or remove hot mixture and rake the mixture as required to obtain a course that when completed will conform to requirements specified herein. Broadcasting or fanning of mixture over areas being compacted is prohibited. When segregation occurs in the mixture during placing, suspend spreading operation until the cause is determined and corrected. Correct irregularities in alinement left by the spreader by trimming directly behind the machine. Immediately after trimming, compact edges of the course by tamping laterally with a metal lute or by other approved methods. Distortion of the course during tamping is prohibited.
3. Joints shall present the same texture and smoothness as other portions of the course, except permissible density at the joint may be up to 2 percent less than the specified course density. Carefully make joints between old and new pavement or within new pavements in a manner to ensure a thorough and continuous bond between old and new sections of the course. Vertical contact surfaces of previously constructed sections that are coated with dust, sand, or other objectionable material shall be painted with a thin uniform coat of emulsion or other approved bituminous material just before Finish Surface Texture of Wearing Course: Visually check final texture for uniformity and reasonable compactness and tightness. Final wearing course with a surface texture having undesirable irregularities such as segregation, cavities, pulls or tears, checking, excessive exposure of coarse aggregates, sand streaks, indentations, ripples, or lack of uniformity shall be removed and replaced with new materials.

END OF SECTION 02511

## SECTION 02520

## PORTLAND CEMENT CONCRETE PAVING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes exterior portland cement concrete paving for the following:
  - 1. Curbs and gutters.
  - 2. Walkways.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 2 Section "Earthwork" for subgrade preparation, grading and subbase course.
  - 2. Division 3 Section "Cast-in-Place Concrete" for general building applications of concrete.
  - 3. Division 7 Section "Paving Joint Sealants" for joint fillers and sealants within concrete paving and at joints with adjacent construction.

## 1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, dry-shake finish materials, and others if requested by Contracting Officer.
- C. Material certificates in lieu of material laboratory test reports when permitted by Contracting Officer. Material certificates shall be signed by manufacturer and Contractor certifying that each material item complies with or exceeds requirements. Provide certification from admixture manufacturers that chloride content complies with requirements.

## 1.4 QUALITY ASSURANCE

- A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.
  - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
  - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
  - 3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
- B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Concrete Testing Service: Employ a qualified independent testing agency to perform materials evaluation tests and to design concrete mixes.

## 1.5 PROJECT CONDITIONS

Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## PART 2 - PRODUCTS

### 2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves of a 100-foot or less radius.
- B. Form Release Agent: Provide commercial formulation form-release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

### 2.2 REINFORCING MATERIALS

- A. Reinforcing Bars and Tie Bars: ASTM A 615, Grade 60, deformed.
- B. Plain, Cold-Drawn Steel Wire: ASTM A 82.
- C. Deformed-Steel Welded Wire Fabric: ASTM A 497.
- D. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.
- E. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Use wire bar-type supports complying with CRSI specifications.

## 2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.  
  
Use one brand of cement throughout Project unless otherwise acceptable to Contracting Officer.
- B. Fly Ash: ASTM C 618, Type F.
- C. Normal-Weight Aggregates: ASTM C 33, Class 4, and as follows. Provide aggregates from a single source.
  - 1. Maximum Aggregate Size: 1-1/2 inches.
  - 2. Do not use fine or coarse aggregates that contain substances that cause spalling.
  - 3. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.
- D. Water: Potable.

## 2.4 ADMIXTURES

- A. Provide concrete admixtures that contain not more than 0.1 percent chloride ions.
- B. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- C. Water-Reducing Admixture: ASTM C 494, Type A.

- D. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
- G. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
- H. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Air-Entraining Admixture:
    - a. Air-Tite or Amex 210; Cormix Construction Chemicals.
    - b. Air-Mix or Perma-Air; Euclid Chemical Co.
    - c. Darex AEA or Daravair; W.R. Grace & Co.
    - d. MB-VR or Micro-Air; Master Builders, Inc.
    - e. Sealtight AEA; W.R. Meadows, Inc.
    - f. Sika AER; Sika Corp.
  - 2. Water-Reducing Admixture:
    - a. Chemtard; ChemMasters Corp.
    - b. Type A Series; Cormix Construction Chemicals.
    - c. Eucon WR-75; Euclid Chemical Co.
    - d. WRDA; W.R. Grace & Co.
    - e. Pozzolith Normal or Polyheed; Master Builders, Inc.
    - f. Metco W.R.; Metacrete Industries.
    - g. Plastocrete 161; Sika Corp.
  - 3. High-Range Water-Reducing Admixture:
    - a. Super P; Anti-Hydro Co., Inc.
    - b. Cormix 2000, PSI Super, or Melmet; Cormix Construction Chemicals.
    - c. Eucon 37; Euclid Chemical Co.
    - d. WRDA 19 or Daracem; W.R. Grace & Co.
    - e. Rheobuild or Polyheed; Master Builders, Inc.
    - f. Superslump; Metacrete Industries.
    - g. Sikament 300; Sika Corp.
  - 4. Water-Reducing and Accelerating Admixture:
    - a. Q-Set; Conspec Marketing & Manufacturing Co.
    - b. Gilco Accelerator or Lub NCA; Cormix Construction Chemicals.
    - c. Accelguard 80; Euclid Chemical Co.

- d. Daraset; W.R. Grace & Co.
- e. Pozzutec 20; Master Builders, Inc.
- f. Accel-Set; Metacrete Industries.

5. Water-Reducing and Retarding Admixture:

- a. Type D Series; Cormix Construction Chemicals.
- b. Eucon Retarder 75; Euclid Chemical Co.
- c. Daratard-17; W.R. Grace & Co.
- d. Pozzolite R; Master Builders, Inc.
- e. Plastiment; Sika Corporation.

## 2.5 CURING MATERIALS

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
  - 1. Waterproof paper.
  - 2. Polyethylene film.
  - 3. White burlap-polyethylene sheet.
- C. Clear Solvent-Borne Liquid Membrane-Forming Curing Compound: ASTM C 309, Type I, Class A or B, wax free.
- D. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B. Provide material that has a maximum volatile organic compound (VOC) rating of 350 mg per liter.
- E. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
- F. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
  - 1. Clear Solvent-Borne Liquid Membrane-Forming Curing Compound:
    - a. Clear Cure; Anti-Hydro Co., Inc.
    - b. Spartan-Cote; The Burke Co.
    - c. All Resin; Conspec Marketing & Mfg. Co.
    - d. Sealco 309; Cormix Construction Chemicals.
    - e. Day-Chem Cure and Seal; Dayton Superior Corp.
    - f. Diamond Clear; Euclid Chemical Co.
    - g. #64 Resin Cure-Clear; Lambert Corp.

- h. L&M Cure R; L&M Construction Chemicals, Inc.
  - i. Masterkure; Master Builders, Inc.
  - j. 3100 Series; W.R. Meadows, Inc.
  - k. Seal N Kure; Metalcrete Industries.
  - l. Kure-N-Seal; Sonneborn-Chemrex.
  - m. Horn Clear Seal; Tamms/A.C. Horn.
- 2. Clear Waterborne Membrane-Forming Curing Compound:
  - a. Clear Cure Water Base; Anti-Hydro Co., Inc.
  - b. Spartan Cote WB; The Burke Co.
  - c. W.B. Resin Cure; Conspec Marketing and Mfg. Co.
  - d. Sealco VOC; Cormix Construction Chemicals.
  - e. Safe Cure and Seal (J-18); Dayton Superior Corp.
  - f. Diamond Clear VOX; Euclid Chemical Co.
  - g. Aqua Kure-Clear; Lambert Corp.
  - h. Dress & Seal #22 WB; L&M Construction Chemicals, Inc.
  - i. Masterkure 100W; Master Builders, Inc.
  - j. 1100 Clear Series; W.R. Meadows, Inc.
  - k. Metcure; Metalcrete Industries.
  - l. Kure-N-Seal WB; Sonneborn-Chemrex.
  - m. Horncure 100; Tamms/A.C. Horn.
- 3. Evaporation Control:
  - a. Aquafilm; Conspec Marketing and Mfg. Co.
  - b. Eucobar; Euclid Chemical Co.
  - c. E-Con; L&M Construction Chemicals, Inc.
  - d. Confilm; Master Builders, Inc.
  - e. Waterhold; Metalcrete Industries.

## 2.6 RELATED MATERIALS

- A. Traffic Paint: Alkyd-resin ready-mixed, complying with AASHTO M 248, Type S.  
  
Color: Yellow.
- B. Bonding Agent: Acrylic or styrene butadiene.
- C. Epoxy Adhesive: ASTM C 881, two-component material suitable for dry or damp surfaces. Provide material type, grade, and class to suit requirements.
- D. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

## 1. Bonding Agent:

- a. Acrylic Bondcrete; The Burke Co.
- b. Strongbond; Conspec Marketing and Mfg. Co.
- c. Day-Chem Ad Bond (J-40); Dayton Superior Corp.
- d. SBR Latex; Euclid Chemical Co.
- e. Daraweld C; W.R. Grace & Co.
- f. Everbond; L&M Construction Chemicals, Inc.
- g. Acryl-Set; Master Builders Inc.
- h. Intralok; W.R. Meadows, Inc.
- i. Acrylpave; Metalcrete Industries.
- j. Sonocrete; Sonneborn-Chemrex.
- k. Stonlock LB2; Stonhard, Inc.
- l. Strong Bond; Symons Corp.

## 2. Epoxy Adhesive:

- a. Burke Epoxy M.V.; The Burke Co.
- b. Spec-Bond 100; Conspec Marketing and Mfg. Co.
- c. Resi-Bond (J-58); Dayton Superior.
- d. Euco Epoxy System #452 or #620; Euclid Chemical Co.
- e. Concrecive Standard Liquid; Master Builders, Inc.
- f. Rezi-Weld 1000; W.R. Meadows, Inc.
- g. Metco Hi-Mod Epoxy; Metalcrete Industries.
- h. Sikadur 32 Hi-Mod; Sika Corp.
- i. R-600 Series; Symons Corp.
- j. Epoxitite Binder 2390; Tamms/A.C. Horn, Inc.

## 2.7 CONCRETE MIX

- A. Prepare design mixes for each type and strength of normal-weight concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs. Limit use of fly ash to 25 percent of cement content by weight.
- B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:
  1. Compressive Strength (28-Day): 3000 psi.
  2. Maximum Water-Cement Ratio at Point of Placement: 0.45.
  3. Slump Limit at Point of Placement: 3 inches. Slump limit for concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site-verified 2-to-3-inch



slump concrete.

- C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows with a tolerance of plus or minus 1-1/2 percent: Air Content: 5.5 percent for 1-1/2-inch maximum aggregate.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

## 2.8 CONCRETE MIXING

Ready-Mixed Concrete: Comply with requirements and with ASTM C 94. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 SURFACE PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.
- C. Install 2" sand cushion under sidewalks.

### 3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
- B. Check completed formwork and screeds for grade and alignment to following tolerances:
  - 1. Top of Forms: Not more than 1/8 inch in 10 feet.

- 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.
- C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.
- D. Sidewalks shall be a minimum thickness of 4 inches.

### 3.3 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement. Stop reinforcement at curb expansion joints.

### 3.4 JOINTS

- A. General: Construct contraction, construction, and expansion joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
- B. Contraction Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as shown on Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows: 20 feet on centers, minimum at curbs; 5 feet on center at walks.
- C. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into hardened concrete when cutting action will not tear, abrade, or otherwise damage surface and before development of random contraction cracks.
- D. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at isolation joints.
  - 1. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.

2. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- E. Expansion Joints: Form expansion joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 60 feet at curbs and 20 feet at walks, unless indicated otherwise.
  2. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
  3. Provide dowels of same size as reinforcement at joints in curbs as detailed. Do not continue reinforcement across expansion joints.
  4. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
  5. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- F. Installation of joint fillers and sealants is specified in Division 7 Section "Paving Joint Sealants."

### 3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place. When concrete placing is interrupted for more than 1/2 hour, place a

construction joint.

- F. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.
- H. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.
- I. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.
- J. Slip-Form Pavers: When automatic machine placement is used for paving, submit revised mix design and laboratory test results that meet or exceed requirements. Produce paving to required thickness, lines, grades, finish, and jointing as required for formed paving. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- K. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- L. Cold-Weather Placement: Comply with provisions of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

- M. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
  3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.6 CONCRETE FINISHING

- A. Float Finish: Begin floating when bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.
- B. Light Broom Finish: Draw a soft bristle broom across concrete surface perpendicular to line of traffic to provide uniform fine line texture.
- C. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

### 3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.
- B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.
- C. Begin curing after finishing concrete but not before free water has disappeared

from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
  - a. Water.
  - b. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with a 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.8 TRAFFIC PAINT

Traffic Paint: Apply traffic paint for striping and other markings with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide a 15-mil minimum wet film thickness.

### 3.9 FIELD QUALITY CONTROL TESTING

- A. Employ a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling Fresh Concrete shall comply to ASTM C 172, except modified for slump to comply with ASTM C 94.
1. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
  2. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test but no less than one test for each day's pour of each type of air-entrained concrete.

3. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
  4. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
  5. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. Test one specimen at 7 days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.
- C. Test results will be reported in writing to Contrating Officer, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in paving, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- E. Additional Tests: The testing agency will make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Contracting Officer's Representative. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Test will be made at no additional cost to the government.

### 3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.
- B. Drill test cores where directed by Contracting Officer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to paving with epoxy adhesive.

- C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.

END OF SECTION 02520



## SECTION 02521

## PORTLAND CEMENT CONCRETE (AIRCRAFT) PAVING

## PART 1 - GENERAL

## 1.1 INTERFERENCE WITH ADJACENT WORK

The Contractor shall cooperate fully with all utility forces of the owner or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the work, and shall schedule the work so as to minimize interference with the work of others.

## 1.2 INSPECTION OF THE WORK

The work shall be conducted under the general direction of the Contracting Officer's Representative to insure strict compliance with the requirements of the contract documents.

## 1.3 SAFETY

Appropriate first aid facilities and supplies shall be kept at the site of the work, and the Contractor shall provide and maintain all measures required by the applicable requirements of the Occupational Safety and Health Administration.

## 1.4 CONTRACTOR'S WORK AND STORAGE AREA

- A. The Contracting Officer will designate and arrange for the Contractors to use a portion of the property adjacent to the work for his exclusive use during the term of the Contract as a storage and shop area for his construction operations relative to this project.
- B. Parking areas for the Contractor and his employees will be designated by the Contracting Officer.

## 1.5 DUST ABATEMENT

The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures whenever and as often as necessary to prevent his operation from producing dust in amounts damaging to property, or causing a nuisance to persons occupying buildings in the vicinity.

## 1.6 CONTROL OF FOREIGN OBJECT DAMAGE

The Contractor shall during all operations incident to this project make sure that pieces of rock, dirt, and broken concrete are controlled in such manner that they do not present a hazard to the operation of jet aircraft engines near the area of work.

## 1.7 TESTING

The Contractor shall submit a list with a minimum of three independent testing laboratories for approval by the Contracting Officer's Representative. The testing firms (agencies) used to accomplish testing shall be approved for by the Contracting Officer's Representative prior to any testing being accomplished.

# PART 2 - AIRFIELD SAFETY PRECAUTIONS

## 2.1 OPERATIONS

The Operation of all ground equipment (mobile or stationary), the placement of all materials, and the performance of all work, upon and in the vicinity of all airfields shall be done in accordance with this clause. The requirements of this clause are in addition to any other safety requirements of this Contract.

## 2.2 DEFINITIONS

For purpose of this clause the following definitions shall apply. "Aircraft Parking Apron" means the following: All aircraft parking aprons plus the area 125 feet in width extending beyond edge all around the aprons.

## 2.3 COORDINATION

The Contractor shall report to the Contracting Officer before initiating any work and shall notify him of proposed changes of locations and operations. Generally, work shall be planned and scheduled so as to present minimum possible interference with Aircraft Flying and Maintenance Activities of the Base. The Contractor shall coordinate slabs to be replaced with the Contracting Officer's Representative to minimize the effect upon Aircraft Operations. Contractor may expect that contiguous areas shall be replaced at a given time.

## 2.4 WORKING RESTRICTIONS

- A. The Contractor shall not place any equipment or materials, etc... on the Aircraft Parking Apron without authorization of the Contracting Officer's Representative.
- B. The contractor shall outline all areas hazardous to aircraft with barricades and red

flags by day and with barricades and electric battery operated, low-intensity yellow flasher lights by night.

- C. Work shall be carried on so as to leave that portion of the landing area which is available to aircraft free from hazards, holes, piles of material, and projecting shoulders that might damage an airplane tire.
- D. The contractor shall keep all paved surfaces, such as runways, taxiways, and hardstands, clean at all times and specifically free from small stones which might damage aircraft propellers or jet aircraft.
- F. While work is actually being performed on the airfield by the Contractor, the operation of mobile equipment shall be governed by the safety provision above. At all other times all mobile equipment shall be removed to locations approved by the Contracting Officer at a distance of at least 750 feet from the runway centerline plus any additional distance necessary to insure compliance with the other provisions of this clause.

### PART3 - MATERIALS

#### 3.1 GENERAL

Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. All cement shall be used in the sequence of receipt of shipment unless otherwise directed by the Contracting Officer. Storage of materials shall conform to the requirements of Section 205 of the ACI Specifications.

#### 3.2 COARSE AGGREGATE

Subgrade and Base Course materials shall consist of an intimate mixture of graded aggregate, coarse and fine, and shall be practically free from vegetable or other deleterious substances. Coarse aggregate shall consist of sound, tough, durable particles of fragments of gravel, stone, mine chats, disintegrated granite, crushed concrete, or a combination thereof. Fine aggregate shall be sand, stone dust or other inert finely divided mineral matter. Coarse aggregate material shall meet the State of Oklahoma Highway Department Specifications Section 703.01 "Coarse Aggregate" Type "A" for base course and "Coarse Aggregate Type "B" for subgrade material.

#### 3.3 CONCRETE MATERIAL

A. Materials for concrete shall conform to the following requirements:

1. Cement shall be portland cement conforming to the requirements of

ASTM Designation C 150-82 Cement shall be Type I (Normal). A manufacturer's certificate of compliance with this specification shall be furnished to the Contracting Officer with each shipment.

2. Water shall be fresh, clean, potable, and free of injurious amount of mineral or organic substances.
3. Aggregates shall conform to the requirements of A.S.T.M. C33. Fine aggregate shall be natural sand. Course aggregate for Class A and Class B Concrete, shall be crushed rock. The following general grading requirement shall apply:

a.	Fine Aggregate:
	Sieve Percentage Passing (Weight
	3/8" 100
	No. 4 95 to 100
	No. 8 80 to 100
	No. 16 50 to 85
	No. 30 25 to 60
	No. 50 10 to 30
	No. 100 2 to 10

b.	Coarse Aggregate
	Sieve Percentage Passing (Weight)
	2" ---
	1 1/2" ---
	1" ---
	3/4" 100
	1/2" 90 to 100
	3/8" 40 to 70
	No. 4 0 to 15
	No. 8 0 to 5

- B. Bonding Agent where a bonding agent is required for concrete work shall be a moisture insensitive and low temperature cure hi-modulus epoxy to bond new concrete directly to structurally sound concrete surfaces. The bonding agent shall be freeze-thaw stable and retain its strength and flexibility indefinitely.

1.	PROPERTY	TEST METHOD	RESULT
	Tensile Bond		4800 psi. Avg
	Strength	ASTM D-638	14 days.
	Flexural Bond		
	Strength	ASTM D-790	7400 psi. Avg.

### 3.4 CONCRETE

- A. Flexural Concrete for replacement of concrete slabs, partial slabs and new concrete pavement.
  - 1. Strength: The concrete shall develop a flexural strength of 700 PSI at 28 days.
  - 2. Type: Air-Entrained with an air content of 6% plus or minus 1%.
  - 3. Slump: Minimum: 3 inch; maximum: 5 inches.
- B. Flexural Concrete for repairs to partial slabs and spalled slab corners.
  - 1. Strength: The concrete shall develop a flexural strength of 700 PSI at 28 days.
  - 2. Type: Air-Entrained with an air content of 6% plus or minus 1%.
  - 3. Slump: Minimum: 3 inch; maximum: 5 inches.
- C. Proportioning of Concrete Mixes: concrete ingredients shall be proportioned by weight. The following shall apply:
  - a. Cement: A one cubic foot bag of Portland Cement will be considered as 94 pounds in weight.
  - b. Water: One gallon of water will be considered as 8.33 pounds.
  - c. Aggregate: Coarse aggregate shall be used in the greatest amount consistent with required workability.
- D. Corrective Additions: Corrective additions to remedy deficiencies in aggregate gradation shall be used only with the written approval of the Contracting Officer. When such additions are permitted, the material shall be measured separately for each batch of concrete.
- E. Concrete Design Mixes: The Contractor shall arrange with an approved testing firm for the design and testing of the mixes for each class of concrete to be used in the work. The concrete shall be designed in accordance with the following:
  - a. Specified strength shall be achieved.
  - b. Specified aggregates shall be used.
  - c. Water cement ratio to be the minimum necessary for strength, workability and placement.
  - e. Concrete shall be designed for minimum contraction. Prior to any concrete being delivered to the work, the testing firm shall prepare

specimens of the concrete based on the design mix and test same in accordance with A.S.T.M. C 78 with the test reports being submitted to the Contracting Officer for approval. The tests shall demonstrate the specimen strengths at 7 and 28 days. The Contractor may submit documentation of the proposed design mix for approval if the design mix proposed for the work has been tested and approved satisfactory in the past (using the same materials and proportions). It will not, however, relieve the Contractor of the responsibility of providing concrete of the proper strengths in the work.

- F. Ready-Mixed Concrete: Ready-Mixed concrete, only, shall be used for the work. The concrete shall be supplied by an established ready-mix firm, approved by the Contracting Officer. Truck-mixed concrete shall be furnished. The provisions of A.S.T.M. C 94 shall apply. The Contracting Officer shall have free access at all times to the batch and mixing plant for the sampling of all materials and inspection of all operations performed for the work. The concrete, when delivered to the work, shall be uniform throughout its mass without segregation of ingredients.
- G. Concrete Testing: See PART 5- TESTING of this specification section.

### 3.5 CURING MATERIALS

- A. Kraft Paper: Commercial quality, double sheet Kraft paper type, cemented together with a bituminous material in which are embedded cords or stands of fiber running in both directions, meeting the requirements of A.S.T.M. C 171.
- B. Membrane Curing Compounds: Commercial quality. clear or translucent type, meeting requirements of A.S.T.M. C 309.

### 3.6 EXPANSION JOINTS:

Preformed expansion joint filler, fibre type, sizes as indicated on the drawings, meeting the requirements of A.S.T.M. D 1751.

### 3.7 CONCRETE FORMS:

Of wood or metal or material approved by the Contracting Officer. Wood forms for concealed concrete surfaces shall be No. 2 Common or better lumber. Wood forms for exposed concrete surfaces shall be lined with Douglas Fir concrete form plywood not less than 1/4 inch thick or a treated hard-pressed non-wrapping fiber board concrete form liner not less than 3/16 inch thick. Metal forms shall be of the type that will produce surfaces equivalent to those specified for wood forms.

### 3.8 FORM TIES:

As required for the work.

### 3.9 AIR-ENTRAINING AGENTS:

Conforming to the requirements of A.S.T.M. C 260.

### 3.10. JOINT SEALANT:

Sealant shall be Dow Corning 890 Self Leveling Silicone Joint Sealant or approved equal.

### 3.11. PRIMERS:

The use of primers with the joint sealant is required if recommended by the manufacturer.

### 3.12. DOWELS:

Dowels shall be fabricated or cut to length at the shop or mill prior to delivery to the site. Dowels shall be free of loose flaky rust and loose scale, and shall be clean and straight, and shall be painted or greased prior to installation. Dowels may be sheared to length provided that the deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and does not extend more than 0.04 inch from the end of the dowel. Dowels shall be plain steel bars conforming to ASTM Specification A 306, grade 80; or to ASTM Specification A 499; shall be installed only if needed, and in accordance with drawings and specifications herein.

## PART 4 - EQUIPMENT.

### 4.01. GENERAL.

Machines, tools and equipment used in the performance of the work will be of the proper type and design for the work, subject to the approval of the Contracting Officer, and maintained in a satisfactory safe operating and working condition. The following describes and establishes minimum standards for the major items of equipment to be used in the work. The definitiveness of this list does not preclude the Contractor furnishing additional equipment as required for the work.

### 4.02 CONCRETE CUTTING AND REMOVING EQUIPMENT:

- A. Power Driven Self-Propelled Concrete Saw: Will be equipped with a power drive and a water pump and will be a minimum of 30 HP. Diamond or abrasive saw blades shall be provided for cutting joints to the widths and depths specified, or

for refacing joints where surface films of old sealants cannot be readily removed by sandblasting.

- B. Jack Hammer: Will be 80 lb. Class or larger.
- C. Truck Mounted Pneumatic Concrete Breaker: Will comply generally to the following. Will have power steering, fully hydraulic creep gear-variable creep from 0 to 200 ft. per minute - between 9000 and 14,500 pound per foot of impact. Capable of breaking concrete without disturbing adjacent concrete.

#### 4.3 JOINT SEALING EQUIPMENT:

Equipment used for removing the old joint filler and cleaning the joints and cracks will consist of the following:

1. Joint Plow: Cutting tools to be used for removing old sealant from the joints to the specified depth shall be of the hardened steel, vertical, single cutting edge type, and so fabricated that when mounted in a holding device the cutting edge shall be approximately parallel to the joint walls. The tool will be of such dimensions that it will not damage the sides of the joints and can be adjusted to remove the old material to varying depths. The use of rotary impact routing devices will not be permitted.
2. Routing and Refacing Machine: A self-powered machine operating a rotary cutter or revolving cutting tool designed to completely remove the old joint material and reface each side wall of the joint without damaging the edges, so that the new concrete surfaces are provided for proper bond of the new joint sealer.

#### 4.4 AIR COMPRESSOR:

Air compressors will be portable and capable of furnishing a continuous pressure of not less than 90 pounds pressure per square inch. Suitable moisture traps will be employed to assure delivery of relatively dry air.

#### 4.5 SANDBLASTING EQUIPMENT:

Sandblasting equipment shall include a hose and longwearing 1/4 inch venture-type nozzles of proper size, shape, and opening. The nozzle shall have an adjustable guide that will hold the nozzles aligned with the joint about 1-inch above the pavement surface. The height, angle of inclination and size of the nozzles shall be adjusted as necessary to secure satisfactory results.

#### 4.6 POWER SWEEPER:

Power sweeper will be a vacuum type capable of completely removing all loose joint material and debris from the pavement surface.



#### 4.7 HAND BROOMS:

Hand brooms will be of standard commercial type.

#### 4.8 HAND TOOLS:

Hand tools of each type required will be furnished in sufficient quantity to ensure orderly uninterrupted accomplishment of the work.

### PART 5 - REMOVAL AND REPLACEMENT OF SLABS

#### 5.1 REMOVING OLD CONCRETE

Work performed under this item shall be inaugurated at such time, and prosecuted in such manner as to cause a minimum of inconvenience to aircraft and vehicle traffic of the Base, or to owners of adjacent property. Removing Old Concrete shall consist of breaking-up, removing and satisfactorily disposing of old concrete. Concrete shall be broken up by air driven machinery, or other suitable mean. The use of explosives for breaking-up old concrete will not be permitted. Concrete shall be disposed of by the Contractor at locations to be obtained by him. Care shall be exercised to avoid damage to that portion of the concrete to remain in place, including dowels in the joints. Mechanized concrete-breaking equipment, such as a Hydra-Hammer, or equivalent, shall not be used so close to the boundary of work as to cause an undercut break of slabs or concrete not to be removed. Any existing concrete adjacent to the work which is damaged or destroyed by these operations shall be replaced at the Contractor's entire expense.

#### 5.2 SLAB REPLACEMENT

When an existing slab is to be replaced, a saw cut full depth of the slab shall be made transversely or longitudinally across the slab joints. Any adjacent slabs that are damaged by the Contractor while breaking the concrete or removing the debris shall be replaced at the Contractor's expense.

#### 5.3 PARTIAL SLAB REPLACEMENT

When a portion of an existing slab is to be replaced, a saw cut full depth of the slab shall be made transversely or longitudinally across the slab in the required location, and the concrete shall be removed to provide a vertical face in the remaining portion of the slab. The existing concrete shall be cut to the neat lines shown on the plans or as established by the Contracting Officer's Representative, and any existing concrete beyond the neat lines so established which is damaged or destroyed by these operations shall be replaced at the Contractor's expense.

#### 5.4 REPAIR OF DEFECTIVE PAVEMENT AREAS

Defective pavement areas repaired under this Contract shall be removed and replaced as specified herein with pavements of the thickness and quality required by these specifications. The defective pavement shall be carefully removed in a such manner that the adjacent pavement will not be damaged and the existing keys or dowels at the joints will be left intact. When a portion of a slab is to be repaired, a saw cut at least 2 inches deep shall be made transversely across the slab in the required location, and the concrete shall be removed to provide a vertical face in the remaining portion of the slab. Prior to placement of the fresh concrete, the face of the slab shall be cleaned of debris and loose concrete, and then thoroughly coated with epoxy bonding agent. Sawn surfaces shall be etched by sandblasting prior to application of epoxy bonding agent. Expansion joint filler shall be placed on the vertical faces of adjacent slab at the juncture with the slab to be patched as a bond-breaking medium. Placement of the fresh portland-cement concrete shall be accomplished while the epoxy bonding agent is still tacky and in a such manner that the grout coating will not be removed. Longitudinal and transverse joints of the replaced slab or portion thereof shall be constructed as indicated on the drawings. Joints shall be sealed as specified in PART 7.

#### 5.5 INSPECTION

It is required that all concrete work specified herein shall be subject to inspection and control by the Contracting Officer. No concrete shall be scheduled for placement until arrangements have been made with the Contracting Officer's Representative to be present during all concrete operations.

#### 5.6 DELIVERY TICKETS

The Contractor shall provide delivery tickets for each load of concrete delivered. Each ticket shall show the approved mix design number, the time when the batch was dispatched, when it arrived at the job site, amount of water added and the time unloading began and was completed. In addition, the temperature of the concrete at the beginning of the unloading will be shown. The Contractor will provide the Contracting Officer's Representative a copy of each delivery ticket at end of each day.

#### 5.7 TRANSPORTATION OF MIXED CONCRETE

Transportation of concrete shall be in a truck mixer operating at agitator speed, or in non-agitating equipment conforming to ASTM Standard C 94 except as modified herein. Vehicles transporting concrete mixed partially or completely in stationary mixers used for complete concrete mixing shall be capable of delivering and discharging the concrete without segregation.

#### 5.8 TRUCK MIXERS

Shall be capable of discharging concrete of required consistency without segregation. Distribution of the concrete shall be as specified hereinafter in paragraph: Transportation of concrete. Concrete so manufactured shall comply in every respect with the requirements of these specifications. When a truck mixer is used for complete mixing (transit-mixed) each batch of concrete shall be mixed by not less than 70 nor more than 100 revolutions of the drum at the rate of rotation designated as mixing speed by the manufacturer of the equipment. Any additional mixing shall be done at the speed designated as agitating speed by the manufacturer of the equipment. When necessary for proper control of the concrete, mixing of transit-mixed concrete will not be permitted until the truck mixer is at the site of the concrete placement.

#### 5.9 CONCRETE PLACING SCHEDULE

- A. The Contractor shall submit to the Contracting Officer for approval, all details covering the location of each proposed construction joint. Upon approval of the Contracting Officer, no deviation from the locations or types of joints will be permitted. Submittal of schedule shall be in the manner specified for submittal of Mix Design.
- B. General: Concrete shall be deposited into the forms with reasonable delay from the time all ingredients are charged into the mixing drum. Concrete shall be deposited as close as possible to its final position. The placing of concrete shall be rapid and continuous in the paving lane. Workmen with foreign material on their footwear shall not be permitted to walk in the concrete during placing and finishing operations.

#### 5.10 SPREADING

Hand spreading will be permitted. Mechanical spreaders, if used may be power driven, and shall be so designed and operated as to distribute the plastic concrete evenly between the edge forms. Machines that cause displacement of properly installed side forms or that cause frequent delays due to mechanical failures shall be replaced as directed. The spreading of the concrete shall be performed at such elevations slightly above grades that when properly consolidated the surface will be at the elevation indicated. Hand spreading shall be done with shovels or concrete rakes.

#### 5.11 VIBRATION

Concrete adjacent to forms and installed joints and concrete in layers 6 inches or more in thickness shall be consolidated with mechanical vibrating equipment immediately after spreading. Vibrating equipment shall be of the internal type. Vibrators of this type shall be inserted into the concrete to a depth that will provide the best compaction, but not closer to the sub grade than 2 inches. Vibrators shall not be used to transport or spread the concrete. The vibrators shall operate at a frequency of not less than 5,000 impulses per minute when in the concrete. The amplitude of vibration shall be sufficient to produce satisfactory consolidation of the concrete with the vibrator spacing used. The

duration of vibration shall be limited to that necessary to produce satisfactory consolidation of the concrete. Excessive vibration will not be permitted. Vibrators shall not be operated in the concrete at one location for more than 20 seconds. At least one additional vibrator or sufficient parts for replacing and repairing vibrators assemblies, shall be maintained at the site at all times.

#### 5.12 PLACING DURING COLD WEATHER

If its necessary to place concrete when the temperature of the air, aggregates, or water is below 40 degrees F., or when the unprotected concrete is likely to be subjected to freezing temperatures before the expiration of the specified curing period, placement shall be approved in writing. Such approval shall be contingent upon full conformance with the following provisions: The subgrade shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and/or aggregates shall be heated as necessary to result in the in-place-concrete temperature of between 50 degrees F. and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F. for not less than 72 hours after placing, and at a temperature above freezing for all the remainder for the curing period. Concrete damaged by freezing shall be removed and replaced without additional cost to the Government.

#### 5.13 PLACING DURING WARM WEATHER

During periods of warm weather when the maximum daily air temperature is likely to exceed 85 degrees F., the following precautions shall be taken. The forms and underlying material shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when deposited exceed 90 degrees F. A retarder shall be used for concrete deposited in the forms when the temperature of the concrete exceeds 85 degrees F. The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum. Concrete shall be placed in the forms continuously and rapidly.

#### 5.14 FINISHING

Finishing operations shall be started immediately after placement of the concrete. Finishing may be the machine method but the hand method will be permitted. The sequence of operations shall be as follows: Transverse finishing, longitudinal floating, straightedge finishing, burlap-drag finishing. Finishing equipment and tools shall be maintained clean and in an approved condition.

#### 5.15 TRANSVERSE FINISHING

As soon as placed, the concrete shall be accurately struck off and screeded to the crown and cross section shown and to such elevation that when consolidated and finished, the

surface of the pavement will be free from porous places and will be at the required grade. the finishing machine, if used, shall make at least two trips over each area of pavement, and may make one or two additional trips as necessary to compact the concrete and produce a surface of uniform texture, true to grade. However, excessive manipulation that brings to the surface an excess of mortar and water will not be permitted, and any equipment that cannot produce the required compaction and surface finish with the indicated number of trips will be considered unsatisfactory. The use of a powered, mechanical finishing machine in this paragraph is optional with the Contractor.

#### 5.16 LONGITUDINAL FLOATING

After completion of the transverse finishing, the float shall be used to smooth and finish the pavement to grade. The float shall be used parallel to the centerline of the pavement with a short, quick motion, and shall travel slowly along the pavement, maintaining contact with the surface at all times. If required, additional concrete shall be placed and screeded, and the float used over the same area until a satisfactory surface is produced. In advancing the float, each new position shall lap the previous position by not less than one-half the float length.

#### 5.17 OTHER TYPES OF FINISHING EQUIPMENT

Concrete finishing equipment of types other than specified above may be used on a trial basis. The use of equipment that fails to produce finished concrete of the quality and consistency required by these specifications shall be discontinued, and the concrete shall be finished with equipment and in the manner specified above.

#### 5.18 OTHER TYPES OF FINISHING EQUIPMENT

- A. Equipment: A strike and tamping template and a longitudinal float shall be provided for hand finishing. The template shall be at least 1 foot longer than the pavement width, shall be equipped with handles, and shall have a striking edge at least 4 inches wide. The longitudinal float shall be not less than 10 feet long, and the face used to finish the pavement surface shall be at least 6 inches wide. The float shall be rigid and substantially braced, shall maintain a plane surface on the bottom of the base, and shall have suitable handles for smooth and effective manipulation from the foot bridges. The bottom edges of the base of the float shall be rounded on a radius not exceeding 3/8 inch.
- B. Finishing and Floating: As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that, when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped, and the tamping operation continued until the required compaction and reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If

necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float, and the floating continued over the new and previously floated surfaces.

#### 5.19 STRAIGHTEDGE FINISHING

After the longitudinal floating is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled floats and straightedges. The long-handled floats may be used to smooth and fill in open-textured areas in the pavement surfaces, but their use shall be held to a minimum. The final finish shall be made with the straightedges which shall be used to float the entire pavement surface. The straightedges shall be 12 feet in length and shall be operated from the sides of the pavement and shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 12 foot straightedge held in successive positions parallel and at right angles to the centerline of the pavement and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straightedge and conforms to the surface requirements specified under subparagraph: Surface smoothness hereinafter.

#### 5.20 BURLAP-DRAG FINISHING

When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, the surface of the pavement shall be dragged in the direction of the concrete placement with a multiple-ply burlap drag at least 3 feet in width and equal in length to the width of the slab. The leading transverse edge of the drag shall be securely fastened to a lightweight pole or traveling bridge, and at least 1 foot of the burlap shall be in contact with the pavement during the dragging operation. The drag shall be operated with the burlap moist and the burlap shall be cleaned and changed as required. The dragging shall be carefully done so as to produce a uniform finished surface having a fine sandy texture without disfiguring marks. The surface of the pavement at joints shall be dragged as necessary with a small hand-operated drag following edge tooling. The finished surface of the newly laid pavement shall be kept damp by applying a waterfog or mist with approved spraying equipment until the pavement is covered by the curing medium.

#### 5.21 OUTLETS IN PAVEMENT

Recesses for the tie-down anchors and other outlets in the pavement shall be constructed to conform to the details and dimensions shown. The concrete in these areas shall be carefully finished to provide a surface of the same texture as the surrounding area.

## 5.22 FORM REMOVAL

In cases where forms are used, they shall remain in place at least 12 hours after the concrete has been placed. When conditions are such that the early-strength gain of the concrete is delayed, the forms shall be left in place for a longer period as directed. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing forms. Any concrete found defective after form removal shall be satisfactorily repaired promptly by the Contractor at no cost to the Government.

## 5.23 CURING

Concrete shall be protected against loss of moisture and rapid temperature changes for the least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Failure to provide sufficient cover material of the type selected, failure to maintain saturation in the moist-curing method, lack of adequate water for both curing and other requirements, or other failures to comply with curing requirements shall be cause for immediate suspension of concrete operations. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period. Within 1 hour after removal of forms, the formed surface shall be provided with continuous curing treatment equal to that provided by the method selected for curing the slab surface. Covering material such as mats, water-proof paper, or impermeable sheets used in curing shall be removed as required.

## 5.24 INITIAL CURING

Immediately after the finishing operations have been completed and the concrete has set sufficiently to prevent marring the surface, the forms and entire surface of the newly laid concrete shall be covered with wetted burlap or cotton mats as specified below. The initial moist curing shall be continued for at least 48 hours. The surface of the newly laid concrete shall be kept moist by means of approved fog-spraying equipment until the burlap or cotton-mat coverings are in place. Wetted covers shall not be used when concrete is placed when forecast temperatures will be below 40 degrees F. At the option of the Contractor, membrane curing compound may be applied at the proper time after completion of the finishing operations (before concrete has dried out), and the wet covers placed when the membrane becomes dry to the touch, or membrane may be applied immediately upon removal of the covers. During cold weather initial curing shall be accomplished by use of waterproof-paper blankets specified in paragraph 5.25.

## 5.25 FINAL CURING

Curing of the concrete shall be continued for the duration of the required curing period by one of the following methods. Method 2 shall be used when temperatures below 40

degrees F. are forecast.

- A. Method 1 - Burlap or cotton-mat curing: The covering shall be either burlap or cotton mats. Burlap covers shall consist of two or more layers of burlap having a combined weight of 14 ounces or more per square yard in a dry condition. Cotton mats and burlap strips, after shrinkage, shall be at least 1 foot longer than necessary to cover the entire width and edge of the pavement lane. Adjacent mats shall overlap at least 6 inches. The mats shall be thoroughly wetted before placing and shall be kept continuously wet and in intimate contact with the pavement edges
- B. Method 2 - Waterproof blanket: Immediately after removing the cover used for initial curing, the surface of the concrete shall be thoroughly wetted with a fine spray of water and then covered with waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. The burlap or polyethylene-coated burlap shall be thoroughly saturated with water before placing. The sheets shall be at least 1 foot longer than necessary to cover the entire width and edges of the slab. The sheets shall be placed with the light-colored side up. Adjacent sheets shall overlap not less than 12 inches with the lapped edges securely weighted down or the sheets shall be lapped 6 inches and cemented or taped to form a continuous cover and a completely closed joint. The covering shall be adequately weighted down to prevent displacement or billowing from winds. Coverings shall be in good condition when placed, any tears and holes appearing in the coverings during the curing period shall be repaired immediately by patching.
- C. Membrane curing: Immediately after removing the wet covering used for initial curing, the entire exposed surface of the concrete shall be uniformly coated with a membrane curing compound. The concrete shall not be allowed to dry out before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water. The curing compound shall be applied to the finished surfaces by means of an approved hand sprayer or machine as soon as the free water has disappeared. The sprayer shall have one or more spraying nozzles that can be controlled and operated to completely and uniformly cover the pavement surface with the required amount curing compound. Spraying pressure shall be sufficient to produce a fine spray as necessary to cover the surface thoroughly and completely with a uniform film. Spray equipment shall be maintained in first-class mechanical condition, and the spray nozzle shall have an adequate wind guard. The curing compound shall be applied with an over lapping coverage that will give a two-coat application at a coverage of not more than 400 square feet per gallon for each coat. The application of curing compound by hand-operated pressure sprayers will be permitted. When application is made by hand operated sprayers, the second coat shall be applied in a direction approximately at right angles to the direction of the first coat. The compound shall form a uniform continuous, cohesive film that will not check, crack, or peel, and that will be free from pinholes and other discontinuity. If pinholes, abrasions or other discontinuity exist, an additional



coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above, at no additional cost to the Government. Approved standby facilities for curing concrete pavement shall be provided at an accessible location at the job site for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane curing compound at the proper time. Concrete surfaces to which membrane curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed.

#### 5.26 PLAN GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

The finished surfaces of pavements, when tested as specified hereinafter in paragraph 5.26., shall conform to the grade line and elevations shown and the surface-smoothness requirements specified herein.

#### 5.27 PLAN GRADE

The finished surfaces of airfield (and heliport) pavements shall conform to the lines, grades, and cross sections shown. The finished surfaces of airfield (runway, taxiway and) Apron pavements shall not vary more than 0.04-foot deviation from the approved grade line and elevation will not be permitted in areas where closer conformance with planned grade and elevation is required for the proper functioning of appurtenant structures. The finished surfaces of new abutting pavements shall coincide at their juncture. Where a new pavement abuts an existing pavement, transition pavement strip of the type and dimensions indicated shall be installed.

#### 5.28 SURFACE SMOOTHNESS

The finished surfaces of airfield pavements shall have no abrupt change of 1/8 inch or more and shall not deviate from the testing edge of an approved 12-foot straightedge more than 1/4 inch longitudinal, and 1/4 inch transverse.

#### 5.29 CONCRETE TESTING - GENERAL

The accomplishment of all required tests, to include all arrangements, all labor and materials involved therewith and the payment of all costs therefore shall be considered a part of the contract work (included in the bid price for the work) and shall be the responsibility of the Contractor. The Contractor shall submit a list with a minimum of three independent testing laboratories for approval by the Contracting Officer's Representative. The testing firms (agencies) used to accomplish testing shall be approved for same by the Contracting Officer's Representative prior to any testing being

accomplished. Copies of all required tests shall be submitted to the Contracting Officer's Representative within 72 hours after completion of the tests. Material samples which are requested shall be furnished to the Contracting Officer's Representative for approval prior to delivery of same to the site. An independent testing lab shall be used.

#### 5.30 CONCRETE SLUMP TESTS

A slump test shall be made of each batch of concrete as it is discharged from the mixer by a representative of the testing agency. The sample concrete used shall be taken at three or more regular intervals throughout the discharge of the entire batch, except that samples shall not be made at the beginning or end of discharge. The slump test shall be made in accordance with the provisions of A.S.T.M. Specification C 143. The slumps shall meet the limitations established therefore in the concrete design mixes, paragraph 3.04. If the measured slump falls outside these limits, a check shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the requirements of these specifications and shall be promptly removed and replaced with concrete meeting the specifications at no cost to the Government.

#### 5.31 AIR ENTRAINMENT TESTS

For each 50 cubic yards or fraction thereof concrete of each class delivered daily shall be field tested at site for its air entrainment content with a minimum of one test per day. The tests shall be made by a representative of the testing agency and may be made by either the volumetric method (A.S.T.M. C 173) or the pressure method (A.S.T.M. C 231). The air entrainment content of the concrete shall be as specified in paragraph 3.04. If the air-entrainment falls outside these limits, a check test shall be made immediately on another portion of the same batch. In the event of a second failure, the concrete shall be considered to have failed to meet the requirements of these specifications, and shall be promptly removed and replaced with concrete meeting these specifications at no cost to the Government.

#### 5.32 CONCRETE STRENGTH TESTS

The testing agency's representative shall secure six test beam for each 50 cubic yards or fraction thereof for each class of concrete delivered daily. The test beams shall be made in the field in accordance with A.S.T.M. C 31, then laboratory tested (two test beams at 7 days, two test beams at 28 days and hold two test beam for 60 days) in accordance with A.S.T.M. C 78. Should the test results indicate that the concrete will not meet the minimum allowable strength requirements in paragraph 3.04., the following will apply:

- A. If the fault lies in the design mix, the mix will be changed to one approved by the Contracting Officer's Representative that provides the proper strength based on test results.
- B. The Contracting Officer's Representative shall have the right, at his option, to

order changes in the conditions of temperature and moisture necessary during the curing of the concrete (up to 60 day if required).

- C. The Contractor will be paid per the following "Pay Factor Schedule" for concrete which does not meet the proper strength requirements after 60 days:

**PAY FACTOR SCHEDULE FOR FLEXURAL STRENGTH  
AT THE SPECIFIED TEST INTERVAL**

Strength Deficiency (Based on an Avg of 60 Day Test) (Percent of Contract Unit Price)	Pay Factor
--	------------

psi	
0 - 20	100
21 - 30	85
31 - 40	75
41 - 50	70
51 - 60	60
61 - 75	55
76 - 100	50

Concrete which tests over 100 psi less than specified strength will be replaced by the Contractor at no additional cost to the Government.

- D. Concrete that is defective due to freezing, segregation of ingredients, or any other cause, that is not fully rectifiable in place, will be removed and replaced by the Contractor at no cost to the Government.
- E. Test beams shall be broken at 7 and 28 days. Test beams breaking equal to or above the required strength at 7 days will be just cause to not break the 28 day test beams.

## PART 6 - REMOVAL AND REPLACEMENT OF BASE COURSES

### 6.01 DESCRIPTION

Removal and replacement of Base Course shall consist of removing the existing base material under all areas of full and partial slab replacement, removal, replacement, compaction, and testing of the sub-grade and replacement, compaction, and testing of base material on the prepared sub-grade as herein specified and in conformity with the typical sections shown on drawings.

### 6.02 PROTECTION OF BASE COURSES

Base Courses shall be prepared in sequence ahead of concrete slab construction with base course construction generally limited to that which will be covered by concrete slabs during any one day's operation. The base and sub-grade shall be protected from all damage to include flooding by water. Sub-grade and base courses shall not be constructed or repaired when the atmospheric temperature is below 35 degrees F. When the temperature falls below this temperature, it shall be the responsibility of the Contractor to protect all areas of completed sub-grade or base courses against any detrimental effects of freezing by methods approved by the Contracting Officer's Representative. Any areas of completed sub-grade or base that are damaged by freezing shall be brought to a satisfactory condition by the Contractor in conformance with the requirements of these specifications without additional cost to the Government.

#### 6.03 REPLACEMENT OF SUB-GRADE

Remove existing subgrade a minimum of 30 inches below top of slab. All unstable, foreign, or otherwise objectionable materials or substances shall be removed from the sub-grade and replaced with approved material (Reference Section III for approved material.). The sub-grade shall be thoroughly wetted with water, shaped, and rolled or compacted to the extent and density required in order to place the sub-grade in acceptable condition to receive the base material. The surface of the sub-grade shall be finished to line and grade established and in conformity with the typical section shown on drawings, and any deviation in excess of 1/2 inch in cross section in a length of 12 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompact. Sufficient sub-grade shall be prepared in advance to insure satisfactory prosecution of the work.

#### 6.04 REPLACEMENT OF BASE COURSE

Remove existing base course a minimum of 16 inches below top of slab. Replaced with approved material (Reference Section III for approved material.). The base grade shall be thoroughly wetted with water, shaped, and rolled or compacted to the extent and density required in order to place the base course in acceptable condition to place concrete. The surface of the base course shall be finished to line and grade established and in conformity with the typical section shown on drawings, and any deviation in excess of 1/2 inch in cross section in a length of 12 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompact. Sufficient base course shall be prepared in advance to insure satisfactory prosecution of the work.

#### 6.05 COMPACTION AND TEST OF SUB-GRADE

The sub-grade shall be compacted with mechanical tampers, or other approved methods. Compaction shall continue until sub-grade is compacted through its full depth as shown on the drawings to 95% Standard Density as determined by AASHTO T-180, Method D with the minimum manipulation necessary to achieve this standard. Water content shall be maintained during the compaction procedure at optimum or at 1 1/2% above optimum at the option of the Contracting Officer's Representative. The Contractor shall make such

adjustments in compacting or finishing procedures as may be directed by the Contracting Officer's Representative to obtain true grades, to minimize segregation and degradation, to reduce or accelerate loss or gain of water, and to insure a satisfactory sub-grade course. Any materials which are found to be unsatisfactory will be removed and replaced with satisfactory material or reworked to produce a satisfactory material. The sub-grade course under each replaced concrete slab shall be tested by an approved testing firm at the expense of the Contractor. The location of the test shall be determined by the Contracting Officer's Representative. One test per sub-grade course shall be considered sufficient providing the test results meet project density specifications, above, and on drawings. When the sub-grade for each replacement slab is accepted by the Contracting Officer's Representative, replacement of the base course shall begin immediately, or the procedures covered in paragraph 6.02. shall be accomplished immediately. One copy of all compaction tests shall be submitted to the Contracting Officer's Representative within 72 hours of completion of the tests.

#### 6.07 REPLACEMENT AND COMPACTION OF BASE COURSE

Prior to placing the Base Course, the previously placed sub-grade course shall be cleaned of all foreign substances. The surface of the sub-grade will be inspected by the Contracting Officer's Representative for adequate compaction, surface tolerances, and presence of foreign materials. The base course material shall then be deposited on the sub-grade, sprinkled if directed, and shaped to conform to typical sections shown on drawings. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with satisfactory new material as directed by the Contracting Officer's Representative. The base course shall be sprinkled as required and compacted to the extent necessary to provide not less than 100% Standard Density as determined by AASHTO T-180, Method D. In addition to the required density, the depth of the base course shown on the drawings shall be compacted to the extent necessary to remain firm and stable during replacement and recompaction operations. After each section of base course is accepted as complete, at least one test per replacement concrete slab area shall be made. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements at no additional cost to the Government. Throughout this entire operation, the shape of the base course shall be maintained, and the surface upon completion shall be smooth and in conformity with typical sections shown on the drawings and to the established lines and grades. Any deviation in excess of 1/4 inch in cross section in a length of 12 feet shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and tamping. All irregularities, depressions or weak spots which develop shall be corrected immediately. Should the base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be recompacted and refinished at the expense of the Contractor.

### PART 7 - JOINT RESEALING

#### 7.01 PREPARATION OF JOINTS

The contractor shall remove all in-place sealant to the required depth, reface the joint faces and sandblast the faces, remove all deposited sandblasting sand and other foreign material including water, and shall place a separating or blocking medium as required. These operations shall be accomplished as follows.

#### 7.02 EXISTING SEALANT REMOVAL

The in-place sealant shall be cut loose and removed to the depth shown on the drawings schedule. Removal of sealant shall be to the depth shown on the drawings schedule. Removal of sealant shall be to the depth required to accommodate any separating and/or depth blocking medium used to maintain the specified depth for the new sealant to be installed. Prior to refacing the joint surfaces, all loose old sealant remaining in the joint opening shall be completely removed by blowing with compressed air.

#### 7.03 REFACING OF JOINTS

Refacing of joints shall be accomplished using a power-driven concrete saw with diamond or abrasive blades to remove all residual old sealant and a minimum of concrete from the joint faces to provide exposure of newly clean concrete and, if required, to widen the joint space to the width and depth shown in the drawings. Immediately following the sawing operation, the joint faces and opening shall be thoroughly cleaned using a high pressure water jet to remove all saw cuttings or debris remaining on the faces or in the joint opening. Joints to be resealed are those adjacent and within the repaired areas.

#### 7.04 SAMPLING AND TESTING

Joint sealers shall be tested for conformance with the referenced applicable material specification. Joint sealants shall be sampled at the place of manufacture and tested by independent testing agencies, and no material shall be used in the project prior to receipt by the Contractor and Contracting Officer of written notice that the material meets the laboratory requirements. The laboratory test for bond will be conducted using the primer in accordance with the manufacturer's instruction. The cost of the test samples from each lot of joint sealant will be borne by the manufacturer. If the samples fail to meet specification requirements, the material represented by the sample shall be replaced, and the new material will be tested. Conformance with the requirements of the laboratory tests final acceptance will be based on performance of the in-place sealant. Each container of sealant shall bear identification as to batch or lot number of manufacture.

#### 7.05 EQUIPMENT

All machine, tools, and equipment used in performance of the work required of this section will be inspected and approved by the Government representative prior to use and shall be maintained in a satisfactory working conditions.

## 7.06 SANDBLAST CLEANING

The newly exposed concrete joint face and the pavement surfaces extending about 1/2 inch from the joint edges shall be sandblast cleaned. A multiple pass technique shall be used, until the surfaces are free of any traces of old sealant and free of saw-cutting fines that might prevent bonding of the sealant to the concrete. A minimum of 150 cubic feet per minute of air at a nozzle pressure of 90 pounds per square inch shall be used for sandblasting and final cleaning. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of sand and water.

## 7.07 SEPARATING, BLOCKING AND BOND BREAKING MEDIA

- A. When the joint groove or opening is of greater depth than indicated the lower portion of the groove shall be plugged or sealed off to prevent entrance of the sealant below the depth specified. The material used to seal off the lower portion of the joint shall be readily compressible, nonshrinkable, nonreactive with the sealing compound, nonabsorptive type such as butyl or neoprene foam rubber, and shall not be stretched during insertion in the joint.
- B. Rate of progress of joint preparation. The work required for the removal of existing joint sealant, widening and/or deepening of joint openings, and refacing of joint walls, may proceed at any rate of progress determined necessary by the contractor and approved. The final stages of joint preparation which include sandblasting of the joint faces, air pressure cleaning of joints, and placement of separating, blocking or bond breaking media shall be limited to only that lineal footage of joint that can be resealed during the same work day.

## 7.08 INSTALLATION OF SEALANT

Installation of sealant shall be such that in-place sealant be well bonded to the concrete and free of voids or entrapped air. Sealants which fail to meet specified in-place performance requirements shall be removed and replaced in a satisfactory manner at no additional cost to the Government. All material removed from an unsatisfactory joint shall be wasted.

## 7.09 TIME OF APPLICATION

Joints shall be sealed immediately following the sandblast cleaning of the joint walls, and following the placing of the separating, blocking, and/or bond blocking media. The concrete walls of the joint shall be surface dry, and the atmospheric temperature and pavement temperature within the joint opening shall both be above 50 degrees F. at the time of application of the sealant. Open joints ready for resealing that cannot be sealed under the condition specified herein, or when rains interrupt sealing operations, shall be recleaned prior to installing the sealant.

## 7.11 SEALING THE JOINTS

- A. The joints shall be completely filled flush with the pavement without formation of voids or entrapped air, using equipment specified in paragraph Equipment. Excess or spilled sealant shall be removed from the pavement by approved method and shall be discarded. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. The sealant proportioning equipment shall be checked at the beginning of each day's operation and every 4 hours to determine that the preset volume for each component is being maintained. The material used for these checks may be returned to the proper component reservoir. The joints shall be checked frequently to insure that the newly installed sealant is cured to a tackfree condition within three hours. Contractors opting to seal joints using hand/manual methods shall submit to the Contracting Officer on AF Form 3000 the following:
1. Sealant manufacturer's recommended installation methods brochure.
  2. Sealant manufacturer's recommended equipment listing. Contractors opting to provide hand/manual installation shall secure the services of the manufacturer's technical training instructor to instruct contractor personnel on the use of equipment, mixing of material, installation of material, and quality control of application of the material. Manufacturer's representative shall be in attendance during the initial joint sealant operations and shall stay on the job until the Contracting Officer's Representative accepts the initial installation of sealant as satisfactory.
- B. CRACK REPAIR: Cracks shall be grooved out, full length, to a width as shown on drawings to form new faces with a rotary grooving device or saw to provide a recess for sealing material. After grooving, the cracks will be blown clean with compressed air, sandblasted, and washed with pressure water (90 psi) leaving same ready to receive the sealing material. Optional: Low volume high pressure water (5,000 to 10,000 psi) may be used for the cleaning process. Use same sealant installation method as for joint resealing.

## PART 8 - APRON DRAINAGE/UTILITY SYSTEMS (EXISTING)

### 8.1 GENERAL

The Contractor shall ascertain from the Contracting Officer's Representative the location, layout, depths, size, etc. of any existing apron drainage/utility systems that are located within or below the apron concrete slab system. In removing existing concrete slabs and in excavating or filling of base courses beneath such slabs, the Contractor shall exercise care not to damage these systems. Any such damage shall be promptly repaired by the Contractor at no cost to the owner.

### 8.2 DEFINITION



The areas of grass around the edges of the Aircraft Parking Apron and extending 125' shall be interpreted to be a part of the Existing Apron Drainage Systems.

## PART 9 - AIRCRAFT TIE DOWNS (EXISTING)

### 9.01. GENERAL

The Contractor shall preserve all existing Aircraft Tie Down and reinstall in accordance with the details shown on the plans. Tie Downs shall be measured and marked on a set of plans, maintained on the job by the Contractor, prior to slab demolition. Any Tie Down damaged during demolition shall be replaced by the Contractor.

## PART 10 - DRAWINGS

It is intended that the Drawings and Specifications shall form a guide for the entire work, complete, to be accomplished under this Contract. Where an item is not specifically mentioned and is reasonably necessary for the complete work, the Contractor shall furnish and install same under this Contract.

### 10.1 CORRELATION OF THE DRAWINGS & SPECIFICATIONS

Each section of the Specifications and the correlated Drawings form a complete set of plans for the work to be accomplished under the specific Section, with all the technical sections and corresponding Drawings forming the complete set of plans for the entire work. Neither the technical sections of the Specifications nor the Drawings shall be considered complete without the other. Where an item is mentioned in the Drawings and not in the Specifications, it shall be considered to be binding under the Contract as though mentioned in both.

### 10.2 SCOPE OF WORK - EACH SPECIFICATION SECTION & RELATED DRAWING

The work consists of furnishing all plant, labor, equipment, appliances, material, and utilities and in performing all operations required for the accomplishment of the area of work covered by each Specification Section and correlated Drawings.

### 10.3 DRAWING DIMENSIONS

The Drawings shall not be scaled to obtain dimensions. Unless otherwise indicated, the dimensions shown on the drawings shall apply and shall be used as basis to determine dimensions not shown.

### 10.4 EXISTING CONSTRUCTION

Where existing construction is involved in the work, the Contractor shall verify all such construction as to type, materials, method of construction, finishes, and dimensions thereof.

## 10.5 USE OF THE TERM "OR EQUAL"

Whenever an article or material is defined by describing a proprietary product, or by using the name of a manufacturer, the term "or equal", if not inserted, shall be implied. The specific article or material mentioned shall be understood as establishing a minimum standard as to the type, function, standard of design, durability, efficiency and quality desired and shall not be constructed so as to exclude other manufacturer's products of comparable characteristics. However, should another article, product, or material be substituted for that specified, the burden of proof as to its being equal to that specified shall rest with the Contractor and shall require the Contracting Officer's Representative approval prior to being used in the work.

## PART 11 - PAVEMENT MARKINGS

### 11.1 GENERAL

**APPLICABLE PUBLICATIONS.** The publications listed below form a part of this specification to the extent referenced. The publication are referred to in the text by the basic designation only.

- A. Beads (Refro-Reflective Glass Spheres) shall conform to Federal Specifications TT-B-1325 Type I , gradation A.
- B. Water Emulsion Base Paint shall conform to Federal specification TT-P-1952B

### 11.2 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition.

- A. **Paint Application Equipment:** The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machines with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the strip widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. The equipment used to apply the paint binder to airfield pavements shall be a self propelled or mobile-drawn pneumatic spraying machines with an arrangement of atomizing nozzles capable of applying a line width of 6 inches. The paint applicator shall have a paint reservoirs or tanks of sufficient capacity and suitable gages to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gages in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to insure freedom

from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

- B. Reflective Media Dispenser: The dispenser for applying the reflective media shall be attached to the paint dispenser and operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph RATE OF APPLICATION, at all operating speeds of the applicator to which it is attached.
- C. Surface Preparation Equipment: Approved cleaning equipment shall be used to clean areas on Aircraft Parking Ramp for new traffic markings where indicated on the drawings.

#### 11.3 DELIVERY AND STORAGE:

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

#### 11.4 PAINT:

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields shall confirm to (TT-P-1952,) colors as indicated on drawing.

#### 11.5 REFLECTIVE MEDIA:

Reflective media for airfields shall conform to Fed. Spec. TT-B-1325, Type I, gradation A which have a refractive index 1.5.

#### 11.6 SURFACE PREPARATION:

- A. Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, waterblasting, or approved chemicals. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and

rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleansing, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

B. Cleaning Concrete Curing Compounds: On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by waterblasting. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

1. There is no visible evidence of curing compound on the peaks of the textured concrete surface.
2. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.
3. All remaining curing compound is intact; all loose and flaking material is removed.
4. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.
5. The surface to be marked is dry.

#### 11.7 APPLICATION:

- A. All pavement markings and patterns shall be placed as shown on the plans.
- B. Paint: Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified herein. The contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

#### 11.8 Rate of Application:

- A. Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet per gallon. Glass spheres shall be applied uniformly to the wet paint at a rate of 10 plus or minus 0.5 pounds of glass spheres per gallon of paint.

- B. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.
- C. Drying: The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.
- D. Reflective Media: Application of reflective media shall immediately follow application of pigmented binder. Drop-on application of glass spheres shall be accomplished to insure that reflective media is evenly distributed at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, operations shall be discontinued immediately until deficiency is corrected.

END OF SECTION 02521

## SECTION 02668

## WATER SERVICE PIPING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes water service piping and appurtenances from the source of potable water to a point 5 feet outside the building.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 2 Section "Earthwork" for excavation and backfill required for water service piping and structures.
  - 2. Division 3 Section "Concrete Work" for supports and structures.

## 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for valves, water meter, and identification devices.
- C. Coordination drawings showing pipe sizes, and valves and meter locations and elevations. Include details of underground structures, connections, anchors, and reaction backing. Show other piping in the same trench and clearances from water service piping. Indicate interface and spatial relationship between piping and proximate structures.
- D. Coordination profile drawings showing water service piping in elevation. Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and a vertical scale of not less than 1 inch equals 5 feet. Indicate pipe, valves, structures, meter, anchors, and reaction backing. Show types, sizes, materials, and elevations of other utilities crossing water service piping.
- E. Record drawings at project closeout of installed water service piping and products in accordance with requirements of Division 1.

- F. Maintenance data for valves and water meter, for inclusion in Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout."

#### 1.4 QUALITY ASSURANCE

Comply with requirements of utility supplying water to the project.

#### 1.5 PROJECT CONDITIONS

Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that water service piping may be installed in compliance with the original design and referenced standards.

#### 1.6 SEQUENCING AND SCHEDULING

- A. Coordinate connection to public water main with utility company.
- B. Coordinate with interior water distribution piping.
- C. Coordinate with other utility work.

### PART 2 - PRODUCTS

#### 2.1 PIPE AND PIPE FITTINGS, GENERAL

Pipe and pipe fitting materials shall be compatible with each other. Where more than one type of material or product is indicated, selection is Installer's option.

- A. Ductile-Iron Pipe 4 Inches and Larger: AWWA C151, Class 50, except that pipe smaller than 6-inch size shall be Class 51.
  - 1. Lining: AWWA C104, cement mortar, sealcoated.
  - 2. Gaskets: AWWA C111.
  - 3. Ductile-Iron and Cast-Iron Fittings: AWWA C110, ductile-iron or cast-iron, 250-psi pressure rating; or AWWA C153, ductile-iron compact fittings, 350-psi pressure rating.
    - a. Lining: AWWA C104, cement mortar.
    - b. Gaskets: AWWA C111, rubber.

4. Encasement: AWWA C105, polyethylene film tube.
- B. PVC (Polyvinyl Chloride) Pipe 4 Inches and Larger: AWWA C900; Class 150; with bell end and elastomeric gasket, with plain end for cast-iron or ductile-iron fittings, or with plain end for PVC elastomeric gasket fittings.
  1. Gaskets: ASTM F 477, elastomeric seal.
  2. PVC Couplings and Fittings: AWWA C900, with ASTM F 477 elastomeric seal gaskets.
  3. Ductile-Iron and Cast-Iron Fittings: AWWA C110, ductile-iron or cast-iron, 250-psi pressure rating; or AWWA C153, ductile-iron compact fittings, 350-psi pressure rating; of dimension to match pipe outside diameter.
    - a. Lining: AWWA C104, cement mortar.
    - b. Gaskets: AWWA C111, rubber.

## 2.2 ANCHORAGES

- A. Clamps, Straps, and Washers: ASTM A 506, steel.
- B. Rods: ASTM A 575, steel.
- C. Rod Couplings: ASTM A 197, malleable iron.
- D. Bolts: ASTM A 307, steel.
- E. Cast-Iron Washers: ASTM A 126, gray iron.
- F. Concrete Reaction Backing: Portland cement concrete mix, 3000 psi.
  1. Cement: ASTM C 150, Type I.
  2. Fine Aggregate: ASTM C 33, sand.
  3. Coarse Aggregate: ASTM C 33, crushed gravel.
  4. Water: Potable.

## 2.3 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with



metallic core, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in black letters "CAUTION - WATER LINE BURIED BELOW."

- B. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

## 2.4 FIRE HYDRANTS

- A. General: Cast-iron body, compression-type valve, opening against pressure and closing with pressure, 6-inch (150 mm) mechanical joint inlet, 150 psig (1035 kPa) working pressure.
- B. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
- C. Operating and Cap Nuts: Pentagon 1-1/2 inch (40 mm) point to flat.
- D. Direction of Opening: Open hydrant valve by turning operating nut to the left, or counterclockwise.
- E. Finish: Red exterior alkyd gloss enamel paint.
- G. Wet-Barrel Fire Hydrants: UL 246, FM-approved, two 2-1/2 inch (65 mm) and one 4-1/2 inch (113 mm) outlets, 6-inch (150 mm) mechanical joint inlet.
- H. Wet-Barrel Fire Hydrants: AWWA C503, two 2-1/2 inch (65 mm) and one 4-1/2 inch (113 mm) outlets, 6-inch (150 mm) threaded or flanged inlet, and base section with 6 inch (150 mm) mechanical joint inlet.

## PART 3 - EXECUTION

### 3.1 PREPARATION OF BURIED PIPE FOUNDATION

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation throughout the length of the piping.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of piping. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to

ensure continuous bearing of the pipe barrel on the foundation.

### 3.2 INSTALLATION OF PIPE AND PIPE FITTINGS

- A. Ductile-Iron Pipe: Install with cement-mortar-lined, ductile-iron or cast-iron, mechanical joint or push-on joint fittings and rubber gaskets in accordance with AWWA C600. Polyethylene encasement shall be install in accordance with AWWA C105.
- B. PVC (Polyvinyl Chloride) Pipe: Install with cement-mortar-lined, ductile-iron or cast-iron, mechanical joint or push-on joint fittings and rubber gaskets in accordance with AWWA M23.
- C. Depth of Cover: Provide minimum cover over piping of 12 inches below average local frost depth or 36 inches below finished grade, whichever is greater.

### 3.3 INSTALLATION OF ANCHORAGES

Anchorage: Provide anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.

### 3.4 APPLICATION OF PROTECTIVE COATINGS

Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

### 3.5 INSTALLATION OF IDENTIFICATION

Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.

### 3.6 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have sufficiently hardened. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.
  - 1. Increase pressure in 50-psi increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints

with new materials and repeat test until leakage is within above limits.

### 3.7 CLEANING

- A. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired, prior to use.
- B. Use the purging and disinfecting procedure as described below:
  - 1. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
  - 2. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
  - 3. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.
  - 4. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

### 3.8 COORDINATION

- A. Water Piping Installation Parallel With Sewer Piping
  - 1. Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.
  - 2. Unusual Conditions: When local conditions prevent a separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that the bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.
  - 3. Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling.
  - 4. The sewer manhole shall be of watertight construction and tested in place.
- B. Installation of Water Piping Crossing Sewer Piping
  - 1. Normal Conditions: Water piping crossing above sewer piping shall be

laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

2. Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:
3. Sewer piping passing over or under water piping shall be constructed of AWWA-approved water piping, pressure tested in place without leakage prior to backfilling.
4. Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 18 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.
5. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

END OF SECTION 02668

## SECTION 02711

## FOUNDATION DRAINAGE SYSTEMS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes underground foundation drainage systems, as follows:
  - 1. Footing drainage system.
  - 2. Prefabricated in-plane wall drainage system.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 2 Section "Earthwork" for earthwork compaction requirements.
  - 2. Division 7 Sections for waterproofing requirements.

## 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of foundation drainage material required.
- C. Shop drawings for interfacing with total site drainage system.
- D. Certification signed by Contractor and foundation drainage system Installer that installed materials conform to specified requirements and system was successfully checked and tested prior to covering with filtering and drainage fill.

## PART 2 - PRODUCTS

## 2.1 DRAINAGE PIPE AND FITTINGS

- A. General: Furnish drainage pipe complete with bends, reducers, adapters, couplings, collars, and joint materials.
- B. Polyvinyl Chloride Pipe: ASTM D 2729.
- C. 4" perforate polyvinyl chloride pipes: ASTM D 2729.
- D. Joint Screening: Furnish joint screening of the following for each open-joint portion of drain lines:
  - 1. Heavy mesh burlap.
  - 2. Coal-tar-saturated felt.
  - 3. 18-14 mesh copper screening.
  - 4. Corrosion-resistant metal bands.
  - 5. Synthetic drainage fabric.

## 2.2 COMPOSITE DRAINAGE BOARD

- A. General: Provide prefabricated composite drainage board as part of overall foundation drainage system.
- B. Drainage Core: Manufacturer's standard three-dimensional, nonbiodegradable, plastic material designed to effectively conduct water to foundation drainage system under maximum soil pressures.
  - 1. Minimum flow rate of 15 gpm per foot width at 3600 psf, when tested in accordance with ASTM D 4716.
- C. Filter Fabric: Manufacturer's standard nonwoven geotextile fabric of polypropylene or polyester fibers, or a combination of them.
- D. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
  - 1. "Amerdrain 500," American Wick Drain Corp.
  - 2. "Enkadrain 9120," Akzo Industrial Systems Co.
  - 3. "Battle Drain," Exxon Chemical Company.
  - 4. "Hydroduct 2," W.R. Grace & Co.

5. "Sheet Drain," Greenstreak, Inc.
6. "Miradrain 6000," Mirafi, Inc.
7. "Hydraway 100," Monsanto Company.

## 2.3 SOIL MATERIALS

- A. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense composite.
- B. Drainage Fill: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand with 100 percent passing a 1/2-inch sieve and 0-5 percent passing a No. 50 sieve.
- C. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand with 100 percent passing a 1-1/2-inch sieve and 0-5 percent passing a No. 50 sieve.

## PART 3 - EXECUTION

### 3.1 INSPECTION

General: Examine adjacent surfaces to receive foundation drainage system to verify suitability. Do not begin installation until subsurface conditions are satisfactory to accept drainage system.

### 3.2 INSTALLATION

- A. Apply and compact impervious fill material to raise low areas or where unsatisfactory bearing soil may occur.
- B. Impervious Fill at Footings: After concrete footings have been cured and forms removed, place impervious fill material on subgrade adjacent to bottom of footing. Place and compact impervious fill to dimensions indicated or, if not indicated, not less than 6 inches deep and 12 inches wide.
- C. Filtering Material: Place supporting layer of filtering material over compacted subgrade where drainage pipe is to be laid to depth indicated or, if not indicated, to a compacted depth of not less than 4 inches.

- D.     Laying Drain Pipe: Lay drain pipe solidly bedded in filtering material. Provide full bearing for each pipe section throughout its length to true grades and alignment, and continuous slope in direction of flow.
1.     Lay perforated pipe with perforations down and joints tightly closed in accordance with pipe manufacturer's recommendations. Provide collars and couplings as required.
  2.     Lay open-joint tile units spaced as indicated on drawings or, if not indicated, with 1/4-inch space between ends. Cover top 2/3 of joint opening with joint screening material and tie with corrosion resistant wire. Commercial joint cover assemblies may be provided if acceptable to Architect.
  3.     Provide recesses in excavation bottom to receive bells for drain pipe having bell and spigot ends. Lay pipe with bells facing up slope and with spigot end entered fully into adjacent bell. Seal joint in accordance with local practices having jurisdiction.
- E.     Testing Drain Lines: Test or check lines before backfilling to assure free flow. Remove obstructions, replace damaged components, and retest system until satisfactory. After testing drain lines, place additional filtering material to a depth of 4 inches around sides and top of drains.
- F.     Composite Drainage Board: Coordinate placement of drainage mat with other foundation drainage materials.
- G.     Comply with manufacturer's instructions for securing matting to substrate. Use adhesives and mechanical fasteners as recommended by matting manufacturer. Lap edges of fabric and extend fabric around foundation drainage pipe in accordance with mat manufacturer's recommendations. Protect in-place matting during backfill operations in accordance with matting manufacturer's instructions. Do not use drainage mat as protection board over waterproof membrane unless otherwise approved by membrane manufacturer.
- H.     Drainage Fill: Place drainage fill over drain lines after satisfactory testing and covering of drain lines with filtering material. Completely cover drain lines to a width of at least 6 inches on each side and above top of pipe to within 12 inches of finish grade. Place fill material in layers not exceeding 3 inches in loose depth and compact each layer placed. Overlay drainage fill material with one layer of 15-lb., asphalt- or tar-saturated felt or synthetic drainage fabric, overlapping edges at least 4 inches.
- I.     Fill to Grade: Apply impervious fill material over compacted drainage fill at footing drains, placing material in layers not exceeding 6 inches in loose depth and thoroughly compacting each layer. Carry impervious fill to indicated finish elevations and slope away from building perimeter.



END OF SECTION 02711

## SECTION 02720

## STORM SEWERAGE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes storm sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Division 2 Section "Earthwork" for excavation and backfill required for storm sewerage system piping and structures.
  - 2. Division 2 Section "Sanitary Sewer" for sanitary sewer connecting to storm sewerage system.
  - 3. Division 3 Section "Cast-In-Place Concrete" for cast-in-place concrete drainage structures.

## 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for drainage piping specialties.
- C. Shop drawings for precast concrete storm drainage manholes and catch basins, including frames, covers, and grates.
- D. Shop drawings for cast-in-place concrete or field-erected masonry storm drainage manholes and catch basins, including frames and covers.
- E. Coordination drawings showing pipe sizes, manholes and catch basins locations and elevations. Include details of underground structures and connections. Show other piping in the same trench and clearances from storm sewerage system piping.

Indicate interface and spatial relationship between piping and proximate structures.

- F. Coordination profile drawings showing storm sewerage system piping in elevation. Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and a vertical scale of not less than 1 inch equals 5 feet. Indicate pipe and underground structures. Show types, sizes, materials, and elevations of other utilities crossing sewerage system piping.

#### 1.4 QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of Government and local environmental agency regulations pertaining to storm sewerage systems.
- B. Utility Compliance: Comply with Government and local utility regulations and standards pertaining to storm sewerage systems.

#### 1.5 PROJECT CONDITIONS

Site Information: Perform site survey, research utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards. Locate existing storm sewerage system piping and structures that are to be abandoned and closed.

#### 1.6 SEQUENCING AND SCHEDULING

- A. Coordinate connection to sewer with Government.
- B. Coordinate with other utility work.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cleanouts:
    - a. Ancon, Inc.

- b. Josam Co.
- c. Smith (Jay R.) Mfg. Co.
- d. Wade Div.; Tyler Pipe.
- e. Zurn Industries, Inc.; Hydromechanics Div.

2. Underground Warning Tapes:

- a. Allen Systems, Inc.; Reef Industries, Inc.
- b. Brady (W.H.) Co.; Signmark Div.
- c. Calpico, Inc.
- d. Carlton Industries, Inc.
- e. EMED Co., Inc.
- f. Seton Name Plate Co.

## 2.2 PIPE AND FITTINGS

- A. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is Installer's option.
- B. Hub and Spigot Cast-Iron Soil Pipe and Fittings: ASTM A 74, gray cast iron, for compression gasket joints.
  - 1. Class: Service.
  - 2. Class: Extra Heavy.
  - 3. Gaskets: ASTM C 564, rubber, thickness to match class of pipe.
- C. Hubless Cast-Iron Soil Pipe and Fittings: CISPI 301, gray cast iron, for coupling joints.
  - 1. Couplings: CISPI 310, ASTM C 564 neoprene sealing sleeve, with 300 Series stainless steel corrugated shield and clamp assembly.
  - 2. Heavy-Duty Couplings: ASTM C 564 neoprene sealing gasket, with Type 304 stainless steel housing or shield and stainless steel clamps. Coupling shall be 3 inches wide in sizes 1-1/2 to 4 inches and 4 inches wide in sizes 5 to 10 inches.
  - 3. Heavy-Duty Couplings: ASTM C 564 neoprene sealing gasket, with cast-iron housing and stainless steel bolts.
  - 4. Heavy-Duty Couplings: FM Approved, ASTM C 564 elastomeric sleeve, with stainless steel band and strips or cast-iron housing and corrosion-resisting bolts.
- D. Ductile-Iron Pressure Pipe: AWWA C151, Class 50, for push-on joints.
  - 1. Lining: AWWA C104, asphaltic material seal coat, minimum 1-mil thick.

2. Gaskets: AWWA C111, rubber.
3. Ductile-Iron and Cast-Iron Pipe Fittings: AWWA C110, ductile-iron or cast-iron, or AWWA C153, ductile-iron compact fittings.
  - a. Lining: AWWA C104, asphaltic material seal coat, minimum 1 mil thick.
  - b. Gaskets: AWWA C111, rubber.
- E. Ductile-Iron Culvert Pipe: ASTM A 716, for push-on joints.
  1. Lining: AWWA C104, asphaltic material seal coat, minimum 1 mil thick.
  2. Gaskets: AWWA C111, rubber.
- F. Ductile-Iron Sewer Pipe: ASTM A 746, Class 50, for push-on joints.
  1. Lining: AWWA C104, asphaltic material seal coat, minimum 1 mil thick.
  2. Gaskets: AWWA C111, rubber.
- G. Ductile-Iron Pipe Encasement: AWWA C105, polyethylene film tube.
- H. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for solvent cement or elastomeric gasket joints.
  1. Solvent Cement: ASTM D 2564.
  2. Gaskets: ASTM F 477, elastomeric seal.
- I. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM F 679, T-1 wall thickness, bell and spigot, for elastomeric gasket joints.  
Gaskets: ASTM F 477, elastomeric seal.
- J. Reinforced Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B, for rubber gasket joints. Gaskets: ASTM C 443, rubber.
- K. Nonreinforced Concrete Sewer Pipe and Fittings: ASTM C 14, Class 2, for rubber gasket joints.  
Gaskets: ASTM C 443, rubber.
- L. ABS (Acrylonitrile-Butadiene-Styrene) Sewer Pipe and Fittings: ASTM D 2751, for solvent cement or elastomeric gasket joints.
  1. SDR 35 for 3 to 6 inches.
  2. SDR 42 for 8 to 12 inches.
  3. Solvent Cement: ASTM D 2235.
  4. Gaskets: ASTM F 477, elastomeric seal.
- M. Extra-Strength Vitrified Clay Sewer Pipe and Fittings: ASTM C 700, unglazed, for

socket and spigot joint.

Sealing Elements: ASTM C 425, rubber.

- N. Standard-Strength Vitrified Clay Sewer Pipe and Fittings: ASTM C 700, unglazed, for socket and spigot joint.

Sealing Elements: ASTM C 425, rubber.

- O. Copper Drainage (DWV) Tube: ASTM B 306, drawn condition, for solder joints.

- P. Copper Fittings: ANSI B16.23 cast copper or ANSI B16.29 wrought copper, solder-joint drainage fittings.

1. Solder Filler Metal: ASTM B 32, Alloy Sn50; tin (50 percent)-lead (50 percent).

2. Solder Filler Metal: ASTM B 32, Alloy Sb5; tin (95 percent)-antimony (5 percent).

- Q. Couplings: Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be joined.

1. Sleeves: ASTM C 425, rubber for vitrified clay pipe; ASTM C 443, rubber for concrete pipe; ASTM C 564, rubber for cast-iron soil pipe; and ASTM F 477, elastomeric seal for plastic pipe. Sleeves for dissimilar or other pipe materials shall be compatible with pipe materials being joined.

2. Bands: Stainless steel, one at each pipe insert.

- R. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.  
Gaskets: ASTM C 425, rubber for vitrified clay pipe; ASTM C 443, rubber for concrete pipe; ASTM C 564, rubber for cast-iron soil pipe; and ASTM F 477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.

## 2.3 CLEANOUTS

General: Provide cast-iron ferrule and countersunk brass cleanout plug, with round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.

## 2.4 CONCRETE AND REINFORCEMENT

- A. Concrete: Portland cement mix, 3,000 psi.

1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Reinforcement: Steel conforming to the following:

1. Fabric: ASTM A 185, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.

## 2.5 IDENTIFICATION

Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW."

## PART 3 - EXECUTION

### 3.1 PREPARATION OF FOUNDATION FOR BURIED STORM SEWERAGE SYSTEMS

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid, and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

### 3.2 PIPE APPLICATIONS FOR UNDERGROUND STORM SEWERS

- A. Pipe Sizes 12 Inches and Larger: Reinforced concrete sewer pipe and fittings.
- B. Pipe Sizes 3 to 42 Inches: Extra-strength vitrified clay sewer pipe and fittings.
- C. Pipe Sizes 3 to 42 Inches: Standard-strength vitrified clay sewer pipe and fittings.
- D. Pipe Sizes 4 to 54 Inches: Ductile-iron pressure pipe and fittings.
- E. Pipe Sizes 4 to 54 Inches: Ductile-iron sewer pipe.
- F. Pipe Sizes 14 to 54 Inches: Ductile-iron culvert pipe.

- G. Pipe Sizes 4 to 36 inches: Nonreinforced concrete sewer pipe and fittings.
- H. Pipe Sizes 18 to 36 Inches: PVC sewer pipe.
- I. Pipe Sizes 2 to 15 Inches: Service-class hub and spigot cast-iron soil pipe and fittings.
- J. Pipe Sizes 2 to 15 Inches: Extra-heavy-class hub and spigot cast-iron soil pipe and fittings.
- K. Pipe Sizes 15 Inches and Smaller: PVC solvent cement joint sewer pipe and fittings.
- L. Pipe Sizes 15 Inches and Smaller: PVC gasket joint sewer pipe and fittings.
- M. Pipe Sizes 12 Inches and Smaller: ABS solvent cement joint sewer pipe and fittings.
- N. Pipe Sizes 12 Inches and Smaller: ABS gasket joint sewer pipe and fittings.
- O. Pipe Sizes 1-1/2 to 10 Inches: Hubless cast-iron soil pipe and fittings.
- P. Pipe Sizes 8 Inches and Smaller: Copper Type DWV tube and copper drainage fittings.

### 3.3 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground storm sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as required, to the extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment required with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use approved manholes or catch basins for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings, where different size or material



of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.

- E. Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.
- F. Extend storm sewerage system piping to connect to building drains, of sizes and in locations indicated.
- G. Install 1-inch-thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12 inches beyond each side of pipe. Install directly over and center on pipe center line.
- H. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.

### 3.4 PIPE AND TUBE JOINT CONSTRUCTION AND INSTALLATION

- A. Join and install hub and spigot cast-iron soil pipe and fittings, with compression gaskets in accordance with CISPI "Cast Iron Soil Pipe and Fittings Handbook, Volume I." Use "Service" or "Extra Heavy" class gaskets to match class of pipe and fittings.
- B. Join and install hubless cast-iron soil pipe and fittings with CISPI-type couplings in accordance with CISPI "Cast Iron Soil Pipe and Fittings Handbook, Volume I."
- C. Join and install hubless cast-iron soil pipe and fittings, with heavy-duty-type couplings in accordance with applicable provisions of CISPI "Cast Iron Soil Pipe and Fittings Handbook, Volume I" and with the coupling manufacturer's installation instructions.
- D. Join and install ductile-iron pipe with ductile-iron or cast-iron push-on joint fittings and rubber gaskets in accordance with AWWA C600, except that anchorages are not required. Install polyethylene encasement in accordance with AWWA C105.
- E. Join and install PVC pipe as follows:
  - 1. Solvent cement joint pipe and fittings, joining with solvent cement in accordance with ASTM D 2855 and ASTM F 402.
  - 2. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM D 3212.
  - 3. Installation in accordance with ASTM D 2321.
- F. Join concrete pipe and fittings with rubber gaskets in accordance with ASTM C 443, and install piping in accordance with applicable provisions of ACPA

"Concrete Pipe Installation Manual."

- G. Join vitrified clay pipe and fittings with rubber sealing elements in accordance with ASTM C 425, and install piping in accordance with ASTM C 12.
- H. Join and install ABS pipe as follows:
  - 1. Solvent cement joint pipe and fittings, in accordance with ASTM D 3212 and ASTM F 402.
  - 2. Join pipe and gasketed fittings with elastomeric seals in accordance with ASTM D 3212.
  - 3. Install piping in accordance with ASTM D 2321.
- I. Join copper tube with cast-copper or wrought-copper solder joint; drainage fittings in accordance with the procedures specified in AWS "Soldering Manual." Install tubing in accordance with applicable provisions of CDA "Copper Tube" handbook.
- J. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

### 3.5 CLEANOUTS

Install cleanouts and extension from sewer pipe to cleanout at grade as required. Set cleanout frame and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installed in paving.

### 3.6 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of 3000-psi 28-day compressive-strength concrete.
- C. Make branch connections from side into existing 4- to 21-inch piping by removing section of existing pipe and installing wye fitting into existing piping. Encase entire wye with not less than 6 inches of 3000-psi 28-day compressive-strength concrete.
- D. Make branch connections from side into existing 24-inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to

allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Provide concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
  2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.
- E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

### 3.7 CLOSING ABANDONED STORM SEWERAGE SYSTEM

- A. Abandoned Piping: Close open ends of abandoned underground piping that is required to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.
1. Close open ends of concrete or masonry utilities with not less than 8-inch-thick brick masonry bulkheads.
  2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.
- B. Abandoned Structures: Remove structure and close open ends of the remaining piping or remove top of structure down to not less than 3 feet below final grade; fill structure with stone, rubble, gravel, or compacted dirt, to within 1 foot of top of structure remaining, and fill with concrete.

### 3.8 INSTALLATION OF IDENTIFICATION

Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.

### 3.9 FIELD QUALITY CONTROL

- A. Testing: Perform testing of completed piping in accordance with City of Tulsa

building codes.

- B.     Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
  - 1.     In large, accessible piping, brushes and brooms may be used for cleaning.
  - 2.     Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
  - 3.     Flush piping between manholes, if required by local authority, to remove collected debris.
- C.     Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
  - 1.     Make inspections after pipe has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
  - 2.     If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and reinspect.

END OF SECTION 02720

## SECTION 02730

## SANITARY SEWERAGE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes sanitary sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Division 2 Section "Earthwork" for excavation and backfill required for sanitary sewerage system piping and structures.
  - 2. Division 2 Section "Storm Sewerage" for storm sewer connecting to sanitary sewerage system.
  - 3. Division 3 Section "Concrete Work" for cast-in-place concrete manholes.
  - 4. Division 15 Section "Sanitary Drainage and Vent Systems" for building sanitary drains.
  - 5. Division 15 Section "Drainage and Vent Systems" for building sanitary drains.

## 1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for drainage piping specialties.
- C. Shop drawings for precast concrete sanitary manholes, including frames and covers.
- D. Shop drawings for cast-in-place concrete or field-erected masonry sanitary manholes, including frames and covers.
- E. Coordination drawings showing pipe sizes and manholes, locations, and elevations. Include details of underground structures and connections. Show other piping in

the same trench and clearances from sanitary sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.

- F. Coordination profile drawings showing sanitary sewerage system piping in elevation. Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and a vertical scale of not less than 1 inch equals 5 feet. Indicate pipe and underground structures. Show types, sizes, materials, and elevations of other utilities crossing sewerage system piping.

#### 1.4 QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.
- B. Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage systems.

#### 1.5 PROJECT CONDITIONS

Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that sanitary sewerage system piping may be installed in compliance with original design and referenced standards. Locate existing sanitary sewerage system piping and structures that are to be abandoned and closed.

#### 1.6 SEQUENCING AND SCHEDULING

- A. Coordinate connection to public sewer with utility company.
- B. Coordinate with interior building sanitary drainage piping.
- C. Coordinate with other utility work.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:

- A. Cleanouts:
  - 1. Ancon, Inc.
  - 2. Josam Co.

3. Smith (Jay R.) Mfg. Co.
4. Wade Div.; Tyler Pipe.
5. Zurn Industries, Inc.; Hydromechanics Div.

B. Underground Warning Tapes:

1. Allen Systems, Inc.; Reef Industries, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Calpico, Inc.
4. Carlton Industries, Inc.
5. EMED Co., Inc.
6. Seton Name Plate Co.

## 2.2 PIPE AND FITTINGS

- A. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is Installer's option.
- B. Hub and Spigot Cast-Iron Soil Pipe and Fittings: ASTM A 74, gray cast iron, for compression gasket joints.
1. Class: Service.
  2. Class: Extra Heavy.
  3. Gaskets: ASTM C 564, rubber, thickness to match class of pipe.
- C. Hubless Cast-Iron Soil Pipe and Fittings: CISPI 301, gray cast iron, for coupling joints.
1. Couplings: CISPI 310, ASTM C 564 neoprene sealing sleeve, with 300 Series stainless steel corrugated shield and clamp assembly.
  2. Heavy Duty Couplings: ASTM C 564 neoprene sealing gasket, with Type 304 stainless steel housing or shield and stainless steel clamps. Coupling shall be 3 inches wide in sizes 1-1/2 to 4 inches and 4 inches wide in sizes 5 to 10 inches.
  3. Heavy-Duty Couplings: ASTM C 564 neoprene sealing gasket, with cast iron housing and stainless steel bolts.
  4. Heavy-Duty Couplings: FM Approved, ASTM C 564 elastomeric sleeve, with stainless steel band and strips or cast-iron housing and corrosion-resisting bolts.
- D. Ductile-Iron Pressure Pipe: AWWA C151, Class 50, for push-on joints.
1. Lining: AWWA C104, asphaltic material seal coat, minimum 1 mil thick.
  2. Gaskets: AWWA C 111, rubber.

3. Ductile-Iron and Cast-Iron Pipe Fittings: AWWA C110, ductile-iron or cast-iron, or AWWA C153, ductile-iron compact fittings.
  - a. Lining: AWWA C104, asphaltic material seal coat, minimum 1 mil thick.
  - b. Gaskets: AWWA C111, rubber.
- E. Ductile-Iron Culvert Pipe: ASTM A 716, for push-on joints.
  1. Lining: AWWA C104, asphaltic material seal coat, minimum 1 mil thick.
  2. Gaskets: AWWA C111, rubber.
- F. Ductile-Iron Sewer Pipe: ASTM A 746, Class 50, for push-on joints.
  1. Lining: AWWA C104, asphaltic material seal coat, minimum 1 mil thick.
  2. Gaskets: AWWA C111, rubber.
- G. Ductile-Iron Pipe Encasement: AWWA C105, polyethylene film tube.
- H. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for solvent cement or elastomeric gasket joints.
  1. Solvent Cement: ASTM D 2564.
  2. Gaskets: ASTM F 477, elastomeric seal.
- I. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM F 679, T-1 wall thickness, bell and spigot, for elastomeric gasket joints.  
Gaskets: ASTM F 477, elastomeric seal.
- J. Reinforced Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B, for rubber gasket joints.  
Gaskets: ASTM C 443, rubber.
- K. Nonreinforced Concrete Sewer Pipe and Fittings: ASTM C 14, Class 2, for rubber gasket joints.  
Gaskets: ASTM C 443, rubber.
- L. ABS (Acrylonitrile-Butadiene-Styrene) Sewer Pipe and Fittings: ASTM D 2751, for solvent cement or elastomeric gasket joints.
  1. SDR 35 for 3 to 6 inches.
  2. SDR 42 for 8 to 12 inches.
  3. Solvent Cement: ASTM D 2235.
  4. Gaskets: ASTM F 477, elastomeric seal.
- M. Extra-Strength Vitrified Clay Sewer Pipe and Fittings: ASTM C 700, unglazed, for



socket and spigot joint.

Sealing Elements: ASTM C 425, rubber.

- N. Standard-Strength Vitrified Clay Sewer Pipe and Fittings: ASTM C 700, unglazed, for socket and spigot joint.  
Sealing Elements: ASTM C 425, rubber.
- O. Couplings: Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be joined.
1. Sleeves: ASTM C 425, rubber for vitrified clay pipe; ASTM C 443, rubber for concrete pipe; ASTM C 564, rubber for cast-iron soil pipe; and ASTM F 477, elastomeric seal for plastic pipe. Sleeves for dissimilar or other pipe materials shall be compatible with pipe materials being joined.
  2. Bands: Stainless steel, one at each pipe insert.
- P. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
1. Gaskets: ASTM C 425, rubber for vitrified clay pipe; ASTM C 443, rubber for concrete pipe; ASTM C 564, rubber for cast-iron soil pipe; and ASTM F 477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.
- ## 2.3 MANHOLES
- A. Precast Concrete Manholes: ASTM C 478, precast reinforced concrete, of depth indicated with provision for rubber gasket joints.
1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
  2. Riser Sections: 4-inch minimum thickness; 48-inch diameter, and lengths to provide depth indicated.
  3. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone to match grade rings.
  4. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9 inches total thickness and match 24-inch diameter frame and cover.
  5. Gaskets: ASTM C 443, rubber.
  6. Steps: Cast into base, riser, and top sections sidewall at 12-to 16-inch intervals.
  7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
  8. Channel and Bench: Concrete.

- B. Brick Manholes: Brick and mortar, of depth indicated.
  - 1. Base, Channel, and Bench: Concrete.
  - 2. Wall: ASTM C 32, Grade MS, manhole brick; 8-inch minimum thickness and inside diameter 48 inches with tapered top for a 24-inch frame and cover. Thickness of section of wall deeper than 8 feet shall be 12 inches minimum.
  - 3. Mortar and Parging: ASTM C 270, Type S, using ASTM C 150, Type II Portland cement.
- C. Cast-in-Place Manholes: Reinforced concrete of dimensions and with appurtenances indicated.
  - 1. Bottom, Walls, and Top: Reinforced concrete.
  - 2. Channel and Bench: Concrete.
  - 3. Steps: Cast into sidewall at 12- to 16-inch intervals.
- D. Concrete: Portland cement mix, 3000 psi.
  - 1. Cement: ASTM C 150, Type II.
  - 2. Fine Aggregate: ASTM C 33, sand.
  - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
  - 4. Water: Potable.
- E. Reinforcement: Steel conforming to the following:
  - 1. Fabric: ASTM A 185, welded wire fabric, plain.
  - 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.
- F. Manhole Steps: Wide enough for a man to place both feet on one step and designed to prevent lateral slippage off the step.
  - 1. Material: Ductile iron or cast aluminum.
  - 2. Material: Steel-reinforced plastic.
- G. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, heavy-duty, ductile iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover, indented top design, with lettering "SANITARY SEWER" cast into cover, suitable for vehicular traffic.

## 2.4 CLEANOUTS

General: Provide cast-iron ferrule and countersunk brass cleanout plug, with round

cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.

## 2.5 IDENTIFICATION

Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW."

## PART 3 - EXECUTION

### 3.1 PREPARATION OF FOUNDATION FOR BURIED SANITARY SEWERAGE SYSTEMS

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid, and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

### 3.2 PIPE APPLICATIONS FOR UNDERGROUND SANITARY SEWERS

- A. Pipe Sizes 12 Inches and Larger: Reinforced concrete sewer pipe and fittings.
- B. Pipe Sizes 3 to 42 Inches: Extra-strength vitrified clay sewer pipe and fittings.
- C. Pipe Sizes 3 to 42 Inches: Standard-strength vitrified clay sewer pipe and fittings.
- D. Pipe Sizes 4 to 54 Inches: Ductile-iron pressure pipe and fittings.
- E. Pipe Sizes 4 to 54 Inches: Ductile-iron sewer pipe.
- F. Pipe Sizes 14 to 54 Inches: Ductile-iron culvert pipe.
- G. Pipe Sizes 4 to 36 inches: Nonreinforced concrete sewer pipe and fittings.
- H. Pipe Sizes 18 to 36 Inches: PVC sewer pipe.
- I. Pipe Sizes 2 to 15 Inches: Service-class hub and spigot cast-iron soil pipe and

fittings.

- J. Pipe Sizes 2 to 15 Inches: Extra-heavy-class hub and spigot cast-iron soil pipe and fittings.
- K. Pipe Sizes 15 Inches and Smaller: PVC solvent cement joint sewer pipe and fittings.
- L. Pipe Sizes 15 Inches and Smaller: PVC gasket joint sewer pipe and fittings.
- M. Pipe Sizes 12 Inches and Smaller: ABS solvent cement joint sewer pipe and fittings.
- N. Pipe Sizes 12 Inches and Smaller: ABS gasket joint sewer pipe and fittings.
- O. Pipe Sizes 1-1/2 to 10 Inches: Hubless cast-iron soil pipe and fittings.

### 3.3 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground sanitary sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use manholes for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.
- F. Extend sanitary sewerage system piping to connect to building sanitary drains, of sizes and in locations indicated.

- G. Install 1-inch-thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12 inches beyond each side of pipe. Install directly over and center on pipe center line.
- H. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.

### 3.4 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. Join and install hub and spigot cast-iron soil pipe and fittings with compression gaskets in accordance with CISPI "Cast Iron Soil Pipe and Fittings Handbook, Volume I." Use "Service" or "Extra Heavy" class gaskets to match class of pipe and fittings.
- B. Join and install hubless cast-iron soil pipe and fittings with CISPI-type couplings in accordance with CISPI "Cast Iron Soil Pipe and Fittings Handbook, Volume I."
- C. Join and install hubless cast-iron soil pipe and fittings, with heavy-duty-type couplings in accordance with applicable provisions of CISPI "Cast Iron Soil Pipe and Fittings Handbook, Volume I" and with the coupling manufacturer's installation instructions.
- D. Join and install ductile-iron pipe with ductile-iron or cast-iron push-on joint fittings and rubber gaskets in accordance with AWWA C600, except that anchorages are not required. Install polyethylene encasement in accordance with AWWA C105.
- E. Join and install PVC pipe as follows:
  - 1. Solvent cement joint pipe and fittings, joining with solvent cement in accordance with ASTM D 2855 and ASTM F 402.
  - 2. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM D 3212.
  - 3. Installation in accordance with ASTM D 2321.
- F. Join concrete pipe and fittings with rubber gaskets in accordance with ASTM C 443, and install piping in accordance with applicable provisions of ACPA "Concrete Pipe Installation Manual."
- G. Join vitrified clay pipe and fittings with rubber sealing elements in accordance with ASTM C 425, and install piping in accordance with ASTM C 12.
- H. Join and install ABS pipe as follows:
  - 1. Solvent cement joint pipe and fittings, in accordance with ASTM D 3212 and ASTM F 402.

2. Join pipe and gasketed fittings with elastomeric seals in accordance with ASTM D 3212.
  3. Install piping in accordance with ASTM D 2321.
- I. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

### 3.5 MANHOLES

- A. General: Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channels and benches between inlets and outlet. Set tops of frames and covers flush with finish surface where manholes occur in pavements. Elsewhere, set tops 3 inches above finish surface, unless otherwise indicated.
- B. Place precast concrete manhole sections as indicated, and install in accordance with ASTM C 891.
- C. Construct brick manholes as indicated.
- D. Construct cast-in-place manholes as indicated.
- E. Provide rubber joint gasket complying with ASTM C 443 at joints of sections.
- F. Apply bituminous mastic coating at joints of sections.

### 3.6 CLEANOUTS

Install cleanouts and extension from sewer pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installed in paving.

### 3.7 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of 3000-psi 28-day compressive-strength concrete.

- C. Make branch connections from side into existing 4- to 21-inch piping by removing section of existing pipe and installing wye fitting, into existing piping. Encase entire wye with not less than 6 inches of 3000-psi 28-day compressive-strength concrete.
- D. Make branch connections from side into existing 24-inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
  - 1. Provide concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
  - 2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.
- E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

### 3.8 CLOSING ABANDONED SANITARY SEWERAGE SYSTEM

- A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.
  - 1. Close open ends of concrete or masonry utilities with not less than 8-inch-thick brick masonry bulkheads.
  - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.
- B. Abandoned Structures: Remove structure and close open ends of the remaining piping, or remove top of structure down to not less than 3 feet below final grade; fill structure with stone, rubble, gravel, or compacted dirt, to within 1 foot of top of structure remaining, and fill with concrete.

### 3.9 INSTALLATION OF IDENTIFICATION

Install continuous plastic underground warning tape during back-filling of trench for

underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.

### 3.10 FIELD QUALITY CONTROL

- A. Testing: Perform testing of completed piping in accordance with the International Plumbing Code.
- B. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
  - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
  - 2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
  - 3. Flush piping between manholes, if required by local authority, to remove collected debris.
- C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
  - 1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
  - 2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects correct such defects, and reinspect.

END OF SECTION 02730



## SECTION 02810

## IRRIGATION SYSTEMS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes valves, piping, sprinklers, specialties, accessories, controls, and wiring for lawn irrigation systems.
- B. This Section includes valves, piping, sprinklers, specialties, accessories, controls, and wiring for lawn and shrubbery irrigation systems.
- C. Related Sections: The following Sections contain requirements that relate to this Section: Division 16 Sections for required and/or indicated electrical power materials and installations.
- D. All irrigation system components and installation shall be in accordance with Base Standards. Materials and components options are provided to allow the Contractor to provide a quality product with minimal maintenance, repair and replacement costs.

## 1.3 DEFINITIONS

- A. Pipe sizes used in this Section are nominal pipe size (NPS) in inches. Tube sizes are Standard size in inches. Equivalent SI (metric) sizes are indicated in millimeters (mm) in parentheses.
- B. Supply Piping: Piping from water source to connection to irrigation system pressure piping. Piping is under same pressure as water supply. Piping in this category is not included in this Section.
- C. Pressure Piping: Piping downstream from supply piping to and including control valves. Piping is under irrigation system pressure. Piping in this category includes pressure regulators, water meters, and backflow preventers, when used.

- D. Circuit Piping: Piping downstream from control valves to irrigation system sprinklers, emitters, devices, and drain valves. Piping is under pressure (less than pressure piping) during flow.
- E. Control Valve: Automatic (electrically operated) valve for control water flow to irrigation system zone.
- F. Drain Piping: Downstream from circuit piping drain valves. Piping is not under pressure.
- G. Drain Valve: Automatic (pressure operated) drain valve for draining of irrigation system circuit piping.

#### 1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Location of Sprinklers and Devices: Design shall be by installer. Make minor adjustments necessary to avoid plantings and obstructions.
- B. Minimum Water Coverage: Not less than:
  - 1. Turf Areas: 100 percent.
  - 2. Other Planting Areas: 100 percent.
- C. Components and Installation: Capable of producing piping systems with the following minimum working pressure ratings except where indicated otherwise.
  - 1. Pressure Piping: 150 psig (1035 kPa).
  - 2. Circuit and Drain Piping: 100 psig (690 kPa).

#### 1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data including pressure rating, rated capacity, settings, and electrical data of selected models for the following:
  - 1. Backflow preventers, including test equipment.
  - 2. Pressure regulators.
  - 3. Valves, including general-duty, underground, manual and automatic control,

and quick-coupler types, and valve boxes.

4. Sprinklers, including emitters, drip tubes, and devices.
  5. Controls, including controller wiring diagrams.
  6. Wiring.
  7. Water hammer arresters.
- C. Wiring diagrams for electrical controllers, valves, and devices.
- D. Shop drawings showing irrigation system, including plan layout and locations, types, sizes, capacities, and flow characteristics of irrigation system components. Include water meters, backflow preventers, valves, piping, sprinklers and devices, accessories, controls, and wiring. Show areas of sprinkler spray and overspray.
- E. Coordination drawings showing piping and major system components. Indicate interface and spatial relationship between piping, system components, adjacent utilities, and proximate structures.
- F. Maintenance data for inclusion in "Operating and Maintenance Manual" required for conformance with Division 1 for the following:
1. Backflow preventers, including instructions for testing.
  2. Pressure regulators.
  3. Automatic control valves.
  4. Sprinklers.
  5. Controllers.

## 1.6 QUALITY ASSURANCE

- A. Comply with requirements of utility supplying water for prevention of backflow and backsiphonage.
- B. Comply with requirements of authority with jurisdiction for irrigation systems.
- C. Installer Qualifications: Engage an experienced Installer who has completed irrigation systems similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

- D. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.
- E. Listing and Labeling: Equipment, specialties, and accessories that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in "National Electrical Code," Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- F. Product Options: Irrigation system piping, specialties, and accessories are based on specific types, manufacturers, and models indicated. Components with equal performance characteristics produced by other manufacturers may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by the Contracting Officer. The burden of proof of product equality is on the Contractor.

## 1.7 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Verify that irrigation system piping may be installed in compliance with design and referenced standards.
- B. Site Information: Reports on subsurface condition investigations made during design of the Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions (between soil borings). Government assumes no responsibility for interpretations or conclusions drawn from this information.

## 1.8 SEQUENCING AND SCHEDULING

- A. Maintain uninterrupted water service to building during normal working hours. Arrange for temporary water shutoff with Contracting Officer.
- B. Coordinate irrigation systems work with landscape work specified in Division 2 Section "Landscape Work."

## 1.9 EXTRA MATERIALS

Deliver extra materials to Contracting Officer. Furnish extra materials matching products

installed as described below. Package them with protective covering for storage and label clearly describing contents.

- A. Quick Couplers: Furnish quantity of units equal to 10 percent of amount of each size installed.
- B. Sprinklers: Furnish quantity of units equal to 10 percent of amount of each type installed.
- C. Emitters, Drip Tube, and Devices: Furnish quantity of units equal to 10 percent of amount of each type installed.
- D. Valve Keys: Furnish quantity of tee-handle units equal to 25 percent of amount of each type key-operated, control valve installed.
- E. Quick-Coupler Hose Swivels: Furnish quantity of units equal to 25 percent of amount of each type quick coupler installed.
- F. Quick-Coupler Operating Keys: Furnish quantity of units equal to 25 percent of amount of each type quick coupler installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Backflow Preventers:
    - a. Ames Co., Inc.
    - b. Buckner, Inc.
    - c. Cash by A.W. Cash Valve Mfg. Corp.
    - d. Cla-Val Co.
    - e. Conbraco Industries, Inc.
    - f. Febco.
    - g. Hersey Products, Inc., Grinnell Corp.
    - h. Rain Bird Sprinkler Mfg. Corp.
    - i. Sparco, Inc.
    - j. Watts Regulator Co.

- k. Wilkins Regulator Div., Zurn Industries, Inc.
2. Pressure Regulators:
- a. Bermad.
  - b. A.W. Cash Valve Mfg. Corp.
  - c. Cla-Val Co.
  - d. Conbraco Industries, Inc.
  - e. G A Industries, Inc.
  - f. Honeywell Braukmann.
  - g. O.C. Keckley Co.
  - h. Spence Engineering Co., Inc.
  - i. Watts Regulator Co.
  - j. Wilkins Regulator Div., Zurn Industries, Inc.
3. Gate Valves for Underground Installation:
- a. American Darling Valve Div., American Cast Iron Pipe Co.
  - b. Clow Valve Co. Div., McWane, Inc.
  - c. Kennedy Valve Div., McWane, Inc.
  - d. Stockham Valves & Fittings, Inc.
  - e. Waterous Co.
4. Corporation Stops for Underground Installation:
- a. Ford Meter Box Co., Inc.
  - b. Hays Div., Romac Industries.
  - c. A.Y. McDonald Mfg. Co.
  - d. Mueller Co., Grinnell Corp.
5. Automatic Control Valves:
- a. Buckner, Inc.
  - b. Champion Irrigation Products.
  - c. Hardie by James Hardie Irrigation, Inc., Landscape Div.
  - d. Hit Products Corp.
  - e. Imperial Underground Sprinkler Co.
  - f. Lawnlife by Ceres Products Corp.
  - g. L.R. Nelson Corp.
  - h. Rain Bird Sprinkler Mfg. Corp.
  - i. Richdel by James Hardie Irrigation, Inc., Landscape Div.
  - j. Superior Controls Co., Inc.
  - k. Toro Co.
  - l. Valcon by Automatic Irrigation Equipment Co.
  - m. Weather-matic Sprinkler Div., Telsco Industries.

## 6. Quick Couplers:

- a. Buckner, Inc.
- b. Champion Irrigation Products.
- c. Lawnlife by Ceres Products Corp.
- d. L.R. Nelson Corp.
- e. Rain Bird Sprinkler Mfg. Corp.
- f. Toro Co.
- g. Weather-matic Sprinkler Div., Telsco Industries.

## 7. Sprinklers:

- a. Buckner, Inc.
- b. Champion Irrigation Products.
- c. Hardie by James Hardie Irrigation, Inc., Landscape Div.
- d. Hit Products Corp.
- e. Hunter Industries.
- f. Lawnlife by Ceres Products Corp.
- g. L.R. Nelson Corp.
- h. Rain Bird Sprinkler Mfg. Corp.
- i. Richdel by James Hardie Irrigation, Inc., Landscape Div.
- j. Senninger Irrigation, Inc.
- k. Toro Co.
- l. Weather-matic Sprinkler Div., Telsco Industries.

## 8. Emitters, Drip Tubes, and Devices:

- a. Agrifim Irrigation Products, Inc.
- b. Buckner, Inc.
- c. Hardie by James Hardie Irrigation, Inc., Landscape Div.
- d. Hit Products Corp.
- e. Olson Irrigation Systems.
- f. Pepco Water Conservation Products, Inc.
- g. Rain Bird Sprinkler Mfg. Corp.
- h. Raindrip, Inc.
- i. Salco Products, Inc.
- j. Tornado by Plastro Irrigation, Inc.
- k. Toro Co.
- l. Weather-matic Sprinkler Div., Telsco Industries.

## 9. Controllers:

- a. Buckner, Inc.
- b. Champion Irrigation Products.
- c. Dayni Controls Manufacturing Co.
- d. Hardie by James Hardie Irrigation, Inc., Landscape Div.

- e. Hydro-Electronics, Inc.
- f. Irritrol by James Hardie Irrigation, Inc., Landscape Div.
- g. L.R. Nelson Corp.
- h. Oasis by Hit Products Corp.
- i. Rain Bird Sprinkler Mfg. Corp.
- j. Richdel by James Hardie Irrigation, Inc., Landscape Div.
- k. Superior Controls Co., Inc.
- l. Toro Co.
- m. Valcon by Automatic Irrigation Equipment Co.
- n. WaterSaver by EMC/Hirsch, Inc.
- o. Weather-matic Sprinkler Div., Telsco Industries.

10. Water Hammer Arresters and Area Drains:

- a. Ancon, Inc.
- b. Jones Manufacturing Co., Inc.
- c. Josam Co.
- d. Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
- e. Wade Div., Tyler Pipe Subsid., Tyler Corp.
- f. Zurn Hydromechanics Div., Zurn Industries, Inc.

## 2.2 PIPES AND TUBES

- A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube materials specified below are used.
- B. Copper Tube: ASTM B 88 (ASTM B 88M), Types L and M (Metric designations: Types B and C), water tube, annealed and drawn tempers, with plain ends.
- C. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 1785, PVC 1120, Schedule 40, 160 psig (1100 kPa) minimum pressure rating for 8-inch (200mm) and smaller sizes, with plain ends.
- D. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 1785, PVC 1120, Schedule 80, 250 psig (1725 kPa) minimum pressure rating for 8-inch (200mm) and smaller sizes, with plain and threaded ends.
- E. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 2241; PVC 1120, SDR 17, 250 psig (1725 kPa) minimum pressure rating, with plain ends.
- F. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 2241; PVC 1120, SDR 21, 200 psig (1380 kPa) minimum pressure rating, with plain ends.
- G. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 2241; PVC 1120, SDR 26, 160 psig (1100 kPa) minimum pressure rating, with plain ends.



## 2.3 PIPE AND TUBE FITTINGS

- A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube fitting materials specified below are used.
- B. Copper Tube Fittings: ASME B16.22, wrought copper or cast-brass, solder-joint, pressure type.
- C. Copper Unions: ASME B16.18, cast-copper-alloy body, hexagonal stock, with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded or solder-joint, and threaded ends. Threaded Ends: Threads conforming to ASME B1.20.1.
- D. Cast-Bronze Flanges: ASME B16.24, Class 150, raised ground face, bolt holes spot faced.
- E. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2464, Schedule 80, threaded.
- F. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2467, Schedule 80, socket-type.
- G. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2466, Schedule 40, socket-type.
- H. Dielectric Fittings: Assembly or fitting with insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion. These devices are a combination of copper alloy and ferrous metal; threaded- and solder-end types, matching piping system materials.
  - 1. Dielectric Unions: Factory-fabricated, union assembly, designed for 250 psig (1725 kPa) minimum working pressure at 180 deg F (82 deg C). Include insulating material isolating dissimilar metals and ends with inside threads according to ASME B1.20.1.
  - 2. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150 psig (1035 kPa) or 300 psig (2070 kPa) minimum pressure to suit system pressures.
  - 3. Transition Fittings: Manufactured assembly or fitting, with pressure rating at least equal to that of system and with ends compatible to piping where fitting is to be installed.

## 2.4 JOINING MATERIALS

- A. Refer to Division 15 Section for joining materials not included in this Section. Any other materials and method shall be as approved by Contracting Officer.
- B. Solvent Cement: ASTM F 656 primer and ASTM D 2564 solvent cement in color other than orange.
- C. Solder: ASTM B 32, Alloys Sn95 and E.
- D. Gaskets and Fasteners for Metal and Metal-to-Plastic Flanged Joints: ASME B16.21, nonmetallic, asbestos-free, flat, 1/8-inch (3mm) thickness gaskets and ASME B18.2.1, carbon steel bolts, nuts, and washers.
- E. Gaskets for Plastic Flanged Joints: Materials recommended by plastic pipe and fittings manufacturer.

## 2.5 BACKFLOW PREVENTERS

- A. Description: ASSE Standard backflow preventers, of size required for maximum flow rate and maximum pressure loss required.
  - 1. Working Pressure: 150 psig (1035 kPa) minimum except where otherwise indicated.
  - 2. 2 Inches (50 mm) and Smaller: Bronze body with threaded ends.
  - 3. 2-1/2 Inches (65 mm) and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends. Interior Protective Coating: AWWA C550, epoxy coating for backflow preventers with cast-iron or steel body.
  - 4. Interior Components: Corrosion-resistant materials.
  - 5. Strainer supplied with and compatible for size and capacity with unit, on inlet, where strainer is required.
- B. Hose Connection Vacuum Breakers: ASSE 1011, nickel-plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- C. Reduced-Pressure-Principle Backflow Preventer: ASSE 1013, with (OS&Y) gate valves on inlet and outlet and strainer on inlet. Include test cocks and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves for continuous pressure application.
  - 1. Pressure Loss: 15 psig (103 kPa) maximum, through middle third of flow

range.

2. Gate valves supplied with and compatible for size and testing of unit on inlet and outlet. Valves 2 inches (50 mm) and smaller may be ball valves if these are unit manufacturer's standard valve for this application.
  3. Test Kit: Unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.
- D. Double-Check Backflow Prevention Assemblies: ASSE 1015, with shutoff valves on inlet and outlet and strainer on inlet. Include test cocks with 2 positive-seating check valves for continuous pressure application.
1. Pressure Loss: 12 psig (83 kPa) maximum, through middle third of flow range.
  2. Gate valves supplied with and compatible for size and testing of unit on inlet and outlet. Valves 2 inches (50 mm) and smaller may be ball valves if these are unit manufacturer's standard valve for this application.
  3. Test Kit: Unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.
- E. Antisiphon, Pressure-Type Vacuum Breakers: ASSE 1020, with valves, spring-loaded check valve, and spring-loaded floating disc. Include test cocks and atmospheric vent for continuous pressure application.
1. Pressure Loss: 6 psig (41 kPa) maximum, through middle third of flow range.
  2. Gate valves supplied with and compatible for size and testing of unit on inlet and outlet. Valves 2 inches (50 mm) and smaller may be ball valves if these are unit manufacturer's standard valve for this application.
  3. Test Kit: Unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.

## 2.6 PRESSURE REGULATORS

- A. Description: ASSE 1003, single-seated, direct-operated-type water pressure regulators, rated for initial working pressure of 150 psig (1035 kPa) minimum, with size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed Y-pattern strainer that is compatible with unit for size and capacity.

1. 2 Inches (50 mm) and Smaller: Bronze body with threaded ends.
  2. 2-1/2 Inches (65 mm) and Larger: Bronze or cast-iron body with flanged ends. Interior Protective Coating: AWWA C550, epoxy coating, for regulators with a cast-iron body.
  3. Interior Components: Corrosion-resistant materials.
- B. Description: ASSE 1003, single-seated, direct-operated, integral-bypass-type, water pressure regulators, rated for initial working pressure of 150 psig (1035 kPa) minimum, with size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed Y-pattern strainer that is compatible with unit for size and capacity.
1. 2 Inches (50 mm) and Smaller: Bronze body with threaded ends.
  2. 2-1/2 Inches (65 mm) and Larger: Bronze or cast-iron body with flanged ends. Interior Protective Coating: AWWA C550, epoxy coating, for regulators with a cast-iron body.
  3. Interior Components: Corrosion-resistant materials.
- C. Description: ASSE 1003, pilot-operated-type, single- or double-seated, water pressure regulators, rated for initial working pressure of 150 psig (1035 kPa) minimum, with size, flow rate, and inlet and outlet pressures indicated. Include cast-iron body main valve, bronze-body pilot valve, integral factory-installed or separate field-installed Y-pattern strainer that is compatible with unit for size and capacity.
1. 2-1/2 Inches (65 mm) and Larger: Cast-iron body with AWWA C550, epoxy coating, and flanged ends.
  2. Interior Components: Corrosion-resistant materials.

## 2.7 VALVES

- A. General: Valves are for general-duty and underground applications. Refer to "Valve Applications" Article for locations of various valve types specified in this Article. Refer to "Control Valves" Article for control valves and accessories and "Backflow Preventers" Article for backflow preventer valves.
- B. Nonrising Stem Gate Valves 3 Inches (80 mm) and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings or AWWA C509, resilient seated; bronze stem, cast-iron, or ductile-iron body and bonnet, stem nut, 200 psig (1380 kPa) working pressure; and ends that fit NPS dimension, PVC pipe. Include

elastomeric gaskets.

- C. Plastic Valves: Polyvinyl chloride (PVC) plastic, with 150 psig (1035 kPa) minimum pressure rating, ends compatible with piping where valve is to be installed, and stem nut.
- D. Valve Boxes: Cast-iron box with top section and cover with lettering "WATER," bottom section with base to fit over valve and barrel approximately 5 inches (127 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve. Provide steel tee-handle shutoff rod with each valve box. Include tee-handle, shutoff rod with one pointed end, stem of length to operate valve, and end fitting valve operating nut.
- E. Curb Stops 2 Inches (50 mm) and Smaller: Bronze body, ground key plug or ball, 150 psig (1035 kPa) minimum pressure rating, wide tee head, with inlet and outlet to match service piping material.
- F. Service Boxes for Curb Stops: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover with lettering "WATER" and bottom section with base of size to fit over curb stop and barrel approximately 3 inches (75 mm) in diameter. Provide steel tee-handle shutoff rod with each service box. Include tee-handle, shutoff rod with one pointed end, stem of length to operate curb stop, and slotted end fitting curb stop head.
- G. Cast-Iron, Nonrising Stem Gate Valves, 2-1/2 Inches (65 mm) and Larger: MSS SP-70, Type I, solid wedge disc; nonrising stem and flanged ends. Include all bronze trim; Class 125, ASTM A 126, cast-iron body; and handwheel.
- H. Cast-Iron, Rising Stem Gate Valves, 2-1/2 Inches (65 mm) and Larger: MSS SP-70, Type I, solid wedge disc; rising stem and flanged ends. Include all bronze trim; Class 125, ASTM A 126, cast-iron body; and handwheel.
- I. Bronze, Nonrising Stem Gate Valves, 2 Inches (50 mm) and Smaller: MSS SP-80, Type 1, solid wedge; nonrising, copper-silicon-alloy stem; Class 125, body and screw bonnet of ASTM B 62 cast bronze, with threaded or solder-joint ends. Include polytetrafluoroethylene (PTFE)-impregnated packing, brass packing gland, and malleable-iron handwheel.
- J. Bronze, Rising-Stem Gate Valves, 2 Inches (50 mm) and Smaller: MSS SP-80, Type 2, solid wedge; rising, copper-silicon-alloy stem; Class 125, body and screw bonnet of ASTM B 62 cast bronze, with threaded or solder-joint ends. Include polytetrafluoroethylene (PTFE)-impregnated packing, brass packing gland, and malleable-iron handwheel.
- K. Plastic Valves: Polyvinyl chloride (PVC) plastic, with 150 psig (1035 kPa) minimum pressure rating, ends compatible to piping where valve is to be installed,

and tee handle.

## 2.8 CONTROL VALVES

- A. Description: Manufacturer's standard control valves for circuits, of type and size indicated, and as follows:
1. Provide cast-bronze bodies, unless otherwise indicated.
  2. Key-Operated, Manual Control Valves: MSS SP-80, Class 125, globe valves, fitted for key operation.
  3. Automatic Control Valves: Diaphragm-type, normally closed, with manual flow adjustment, and operated by 24-volt-a.c. solenoid.
  4. Automatic Drain Valves: Designed to open for drainage when line pressure drops below 3 psig (20 kPa).
  5. Quick-Couplers: Factory-fabricated, 2-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key. Locking Top Option: Include vandal-resistant, locking feature with 2 matching keys.
- B. Control Valve Boxes: Polyethylene (PE), acrylonitrile-butadiene-styrene (ABS), fiberglass, polymer concrete, or precast concrete box and cover. Size as required for application. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3 inches (75 mm) maximum to 3/4 inch (19 mm) minimum.
- C. Service Boxes for Key-Operated Control Valves: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover with lettering "WATER," and bottom section with base of size to fit over curb stop and barrel approximately 3 inches (75 mm) in diameter. Include valve key, 36 inches (915 mm) long with tee handle and key end to fit valve.

## 2.9 SPRINKLERS

- A. Description: Manufacturer's standard sprinklers designed to provide uniform coverage over entire area of spray shown on Drawings at available water pressure, as follows:
1. Housings: Brass or plastic, except where material is specified.
  2. Housings: Brass or plastic.

3. Flush, Surface: Fixed pattern, with screw-type flow adjustment.
4. Interior Parts: Brass or other corrosion-resistant materials.
5. Bubbler: Fixed pattern, with screw-type flow adjustment.
6. Shrubbery: Fixed pattern, with screw-type flow adjustment.
7. Pop-Up, Spray: Fixed pattern, with screw-type flow adjustment and stainless-steel retraction spring.
8. Pop-Up, Rotary Spray: Gear drive, full-circle and adjustable part-circle type.
9. Pop-Up, Rotary Impact: Impact drive, full circle and part circle as indicated.
10. Above-Ground, Rotary Impact: Impact drive, full circle and part circle as indicated.

## 2.10 EMITTERS, DRIP TUBES, AND DEVICES

Description: Manufacturer's standard units as shown on submittal Drawings and as follows:

- A. Application Pressure Regulators: Brass or plastic housing, 3/4-inch (20mm) size, with corrosion-resistant internal parts, and capable of controlling outlet pressure to approximately 20 psig (138 kPa).
- B. Strainer/Filter Units: Brass or plastic housing, with corrosion-resistant internal parts, of size and capacity required for emitters, drip tubes, and devices downstream of unit.
- C. Emitters: Plastic body with single outlet, to deliver the following flow at approximately 20 psig (138 kPa):
  1. Flow: 1/2 gallon per hour (1.9 L/hour).
  2. Flow: 1 gallon per hour (3.8 L/hour).
  3. Flow: 2 gallons per hour (7.6 L/hour).
  4. Tubing: Include 120 inches (3000 mm), 1/8-inch (3mm) inside diameter polyethylene (PE) tubing.

- D. Emitters: Plastic body with 6 outlets, to deliver the following flow at approximately 20 psig (138 kPa):
  - 1. Flow Each Outlet: 1/2 gallon per hour (1.9 L/hour).
  - 2. Flow Each Outlet: 1 gallon per hour (3.8 L/hour).
  - 3. Flow Each Outlet: 2 gallons per hour (7.6 L/hour).
  - 4. Tubing: Include 60 feet (18 m), 1/8-inch (3mm) inside diameter polyethylene (PE) tubing.
  - 5. Outlet Caps: Include 6 plastic outlet caps.
- E. Drip Tubes: Flexible polyvinyl chloride (PVC) plastic tube for emitters or other devices indicated, of length indicated, and with plugged end.
  - 1. Size: 1/2-inch (15mm) NPS.
  - 2. Size: 3/4-inch (20mm) NPS.
  - 3. Size: 1-inch (25mm) NPS.
- F. Other Devices: As specified or as required for completed system.

## 2.11 AUTOMATIC CONTROL SYSTEM

- A. Description: Low-voltage controller system, made for control of irrigation system automatic control valves. Controller operates on 120 volts a.c. building power system, provides 24 volts a.c. power to control valves, and includes stations for at least the number of control valves indicated.
- B. Exterior Control Enclosures: Weatherproof enclosure with locking cover and 2 matching keys. Enclosure construction complies with NFPA 70 and NEMA 250, Type 4, and includes provision for grounding.
  - 1. Material: Enameled-steel, sheet metal.
  - 2. Material: Stainless-steel, sheet metal.
  - 3. Material: Molded plastic.
- C. Transformer: Internal-type, and suitable for converting 120 volts a.c. building power to 24 volts a.c. power.



- D. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
- E. Timing Device: Adjustable, 24-hour, 14-day clock to operate any time of day. Include provision for the following settings:
  - 1. Setting to skip operation any day in timer period.
  - 2. Setting for operation every other day.
  - 3. Settings for operation 2 or more times daily.
  - 4. Include manual or semi-automatic operation without disturbing preset automatic operation.
  - 5. Provide Winter/Summer setting to vary the above.
  - 6. Provide NI-CAD battery and trickle charger to automatically power the timing device during power outages.
- F. Wiring: UL 493, solid copper conductor, insulated cable, suitable for direct burial.
  - 1. Feeder Circuit Cables: Type UF, No. 12 AWG minimum, between building and controllers.
  - 2. Low-Voltage, Branch Circuit Cables: Type UF, No. 14 AWG minimum, between controllers and automatic control valves. Jacket color is other than feeder-circuit-cable jacket color. Furnish cables with jackets of different colors for multiple cable installation in same trench.
  - 3. Splicing Materials: Pressure-sensitive thermoplastic tape and other materials required to make specified connections.

## 2.12 WATER HAMMER ARRESTERS

Water Hammer Arresters: ASME A112.26.1M, ASSE 1010, or PDI WH-201, bellows or piston type with pressurized cushioning chamber. Sizes are based on water-supply fixture units, ASME A112.26.1M sizes "A" through "F" and PDI WH-201 sizes "A" through "F."

## 2.13 PRESSURE GAGES

Pressure Gages: ASME B40.1, 4-1/2-inch (115mm) diameter dial, with dial range of 2

times system operating pressure and bottom outlet.

## 2.14 IDENTIFICATION

- A. Refer to Division 2 Section "Earthwork" for plastic underground warning tapes.
- B. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

Investigate and determine available water supply water pressure and flow characteristics.

### 3.2 PREPARATION

Set stakes to identify proposed sprinkler locations. Obtain Contracting Officer's approval before excavation.

### 3.3 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 2 Section "Earthwork."
- B. Underground warning tape installation is specified in Division 2 Section "Earthwork."

### 3.4 PAVING WORK

- A. Cutting and patching of asphalt paving is specified in Division 2 Section "Hot-Mixed Asphalt Paving."
- B. Install piping in sleeves where crossing sidewalks, roadways and parking lots. Install piping sleeves by boring or jacking under existing paving, where possible.

### 3.5 PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings

products listed below. Use pipe, tube, fittings, and joining methods according to the following applications.

- B. Use pipe, tube, fittings, and joining methods according to the following applications.
- C. Pressure Piping Underground: Use the following:
  - 1. 3 Inches (80 mm) and Smaller: Copper tube, Type L (Metric designation: Type B), annealed temper; wrought-copper tube fittings; and soldered joints.
  - 2. 3 Inches (80 mm) and Smaller: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type pipe fittings; and solvent-cemented joints.
  - 3. 3 Inches (80 mm) and Smaller: ASTM D 2241, SDR 17, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type pipe fittings; and solvent-cemented joints.
  - 4. 4 Inches (100 mm) and Larger: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type pipe fittings; and solvent-cemented joints.
  - 5. 4 Inches (100 mm) and Larger: ASTM D 2241, SDR 17, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type pipe fittings; and solvent-cemented joints.
- D. Circuit Piping: Use the following:
  - 1. All Sizes: Copper tube, Type L (Metric designation: Type B), drawn temper; wrought-copper fittings; and soldered joints.
  - 2. All Sizes: Copper tube, Type M (Metric designation: Type C), drawn temper; wrought-copper fittings; and soldered joints.
  - 3. All Sizes: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type pipe fittings; and solvent-cemented joints.
  - 4. All Sizes: ASTM D 1785, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent cemented joints.
  - 5. All Sizes: ASTM D 2241, SDR 17, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type fittings; and solvent-cemented joints.

- 6. All Sizes: ASTM D 2241, SDR 17 or 21, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent-cemented joints.
- E. Branches and Offsets at Sprinklers and Devices: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe with threaded ends; ASTM D 2464, Schedule 80, PVC plastic, threaded fittings; and threaded joints. Option: Plastic piping made for this application may be used instead of pipe and fittings specified.
- F. Drain Piping: Copper tube, Type M (Metric designation: Type C); wrought-copper fittings; and soldered joints.
- G. Drain Piping: ASTM D 1785, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent-cemented joints.
- H. Drain Piping: ASTM D 2241, SDR 21 or 26, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent-cemented joints.
- I. Sleeves: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type fittings; and solvent-cemented joints.
- J. Sleeves: ASTM D 1785, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings; and solvent-cemented joints.

### 3.6 JOINT CONSTRUCTION

- A. Flanged Joints: Align flanges and install gaskets. Assemble joints by sequencing bolt tightening. Use lubricant on bolt threads.
- B. Threaded Joints: Thread pipes with tapered pipe threads according to ASME B1.20.1, apply tape or joint compound, and apply wrench to valve ends into which pipes are being threaded.
- C. Copper Tube and Fittings, Soldered Joints: Construct joints according to CDA No. 404/0 Products Handbook "Copper Tube Handbook."
- D. Polyvinyl Chloride (PVC) Piping Gasketed Joints: Construct joints between underground AWWA-type, cast-iron valves and NPS PVC pipe; with elastomeric seals that fit pipe diameter and valve ends; and lubricant, according to ASTM D 3139.

- E. Polyvinyl Chloride (PVC) Piping Solvent-Cemented Joints: Construct joints according to ASTM D 2672 and ASTM D 2855. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.
- F. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure. Refer to "Piping Systems - Common Requirements" Article for joining dissimilar metal piping.

### 3.7 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General Locations and Arrangements: Submittal drawings shall indicate general location and arrangement of piping systems. Locations and arrangements shall be used to size pipe and calculate friction loss, and in other design considerations. Install piping as required, except where deviations to layout are approved.
- B. Install piping at a uniform slope of 6 inches per 100 feet (1:200) minimum, down to drain points.
- C. Install components having pressure rating equal to or greater than required system operating pressure.
- D. Install piping free of sags and bends.
- E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- F. Install fittings for changes in direction and branch connections.
- G. Piping Connections: Except as otherwise indicated make piping connections as specified below.
  - 1. Install unions, in piping 2 inches (50 mm) and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inch (50mm) or smaller threaded pipe connection.
  - 2. Install flanges, in piping 2-1/2 inches (65 mm) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
  - 3. Install dielectric fittings to connect piping of dissimilar metals.

### 3.8 PIPING INSTALLATION

- A. Install copper tube and copper tube fittings, according to CDA No. 404/0 Products Handbook "Copper Tube Handbook."

- B. Install underground polyvinyl chloride (PVC) plastic pipe according to ASTM D 2774.
- C. Lay piping on solid subbase, uniformly sloped without humps or depressions.
  - 1. Slope circuit piping down toward drain valve minimum of 1/2 inch in 10 feet (1:240).
  - 2. Install polyvinyl chloride (PVC) plastic pipe in dry weather when temperature is above 40 deg F (4 deg C). Allow joints to cure at least 24 hours at temperature above 40 deg F (4 deg C) before testing, unless otherwise recommended by manufacturer.
- D. Drain Pockets: Excavate to sizes required. Backfill with cleaned gravel or crushed stone, graded from 3 inches (75 mm) to 3/4 inch (19 mm) minimum, drain material to 12 inches (300 mm) below grade. Cover drain material with sheet of ASTM D 226, Type II, asphalt-saturated felt and backfill remainder with excavated material.
- E. Minimum Cover: Provide following minimum cover over top of buried piping:
  - 1. Pressure Piping: Greater depth of minimum of 36 inches (915 mm) below finished grade, or not less than 18 inches (460 mm) below average local frost depth.
  - 2. Circuit Piping: 12 inches (300 mm).
  - 3. Drain Piping: 12 inches (300 mm).
  - 4. Sleeves: 24 inches (600 mm).
- F. Water Hammer Arrester: Install between connection to building main and circuit valves, inside building or in valve box as indicated.
- G. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, boring, or jacking.
- H. Install piping under sidewalks and paving in sleeves.

### 3.9 VALVE APPLICATIONS

Submittal drawings shall indicate valve types to be used. Where specific valve types are not indicated, following requirements apply:

- A. Buried Valves 3 Inches (80 mm) and Larger: AWWA, gate valves, nonrising stem, with stem nut and valve box.
- B. Buried Valves 2 Inches (50 mm) and Smaller: Bronze-body, curb stop, with tee head, service box and shutoff rod.
- C. Buried Circuit and Drain Valves: Plastic valves, nonrising stem, with stem nut, valve or service box, and tee-handle shutoff rod.
- D. Pit and Aboveground Installation, Valves 2-1/2 Inches (65 mm) and Larger: MSS, rising stem, gate valves.

### 3.10 VALVE INSTALLATION

- A. Valves: Install underground valves in valve boxes. Install valves and polyvinyl chloride (PVC) pipe with restrained, gasketed joints.
- B. Curb Stops: Install underground curb stops in service boxes.
- C. Control Valves: Install in valve control valve boxes, arranged for easy adjustment and removal. Install union on downstream side.

### 3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity required. Include valves and test cocks. Install according to local plumbing code and health department authorities.
- B. Install pressure-type vacuum breakers minimum of 12 inches (300 mm) above downstream piping system.
- C. Do not install bypass around backflow preventer.
- D. Do not install backflow preventers with drains or vents in areas subject to flooding.
- E. Support backflow preventers, valves, and piping on 3000-psi (20.7MPa) minimum, portland-cement-mix concrete piers.

### 3.12 PRESSURE REGULATOR INSTALLATION

Install pressure regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet and valved bypass where required.

### 3.13 SPRINKLER INSTALLATION

Sprinklers: Flush circuit piping with full head of water and install sprinklers after hydrostatic test is completed.

- A. Install lawn sprinklers at manufacturer's recommended heights.
- B. Install shrubbery sprinklers at heights required.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries, unless otherwise indicated.

### 3.14 AUTOMATIC CONTROL SYSTEM INSTALLATION

- A. Install controllers according to manufacturer's written instructions and as required.
- B. Install free-standing controllers on concrete pads. Where dimensions are not indicated, furnish bases not less than 36 inches (915 mm) by 24 inches (610 mm) by 4 inches (100 mm) thick, and not less than 6 inches (150 mm) greater in each direction than overall dimensions of controller.
- C. Install control wiring in same trench with piping.

### 3.15 CONNECTIONS

- A. Connect piping to sprinklers, devices, valves, control valves, specialties, and accessories.
- B. Connect water supplies to irrigation systems. Include backflow preventers on potable water supplies.
- C. Electrical Connections: Connect to power source, controllers, and automatic control valves.
- D. Minimum requirements for electrical installations are specified in Division 16.
- E. Ground systems according to Division 16.

### 3.16 FIELD QUALITY CONTROL

Testing: Perform hydrostatic test of piping and valves before backfilling trenches. Piping may be tested in sections to expedite work.



- A. Cap and subject the piping system to a static water pressure of 50 psig (345 kPa) above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
- B. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.

### 3.17 CLEANING AND ADJUSTING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.
- B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.
- C. Carefully adjust lawn sprinklers so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade after completion of landscape work.
- D. Adjust settings of controllers and automatic control valves.

### 3.18 COMMISSIONING

- A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturers, proceed as follows:
  - 1. Verify that specialty valves and their accessories have been installed correctly and operate correctly.
  - 2. Verify that specified tests of piping are complete.
  - 3. Check that sprinklers and devices are correct type.
  - 4. Check that damaged sprinklers and devices have been replaced with new materials.
  - 5. Check that potable water supplies have correct type backflow preventers.
  - 6. Energize circuits to electrical equipment and devices.
  - 7. Adjust operating controls.
- B. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinklers are adjusted to final position.

### 3.19 DEMONSTRATION

- A. Demonstrate to Contracting Officer that system meets coverage requirements and that automatic controls function properly.
- B. Demonstrate to Government's maintenance personnel operation of equipment, sprinklers, specialties, and accessories. Review operating and maintenance information.
- C. Provide 10 days' written notice in advance of demonstration.

END OF SECTION 02810

SECTION 02900  
LANDSCAPE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes provisions for the following items:

1. Trees.
2. Shrubs.
3. Plants.
4. Ground cover.
5. Lawns.
6. Soil amendments.
7. Initial maintenance of landscape materials.

B. Related Sections: The following sections contain requirements that relate to this Section.

1. Excavation, filling, and rough grading required to establish elevations shown on drawings is specified in Division 2 Section, "Earthwork."
2. Underground sprinkler system is specified in Division 2 Section, "Underground "Irrigation Systems."

C. Sodding and/or Seeding: Contractor shall provide sodding and/or seeding for all areas shown on plans to receive lawn irrigation system. Sodding and seeding shall be in accordance with this specification Section.

1.3 QUALITY ASSURANCE

- A. Subcontract landscape work to a single firm specializing in landscape work.
- B. Source Quality Control:
  - 1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
  - 2. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Contracting Officer, together with proposal for use of equivalent material.
  - 3. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
  - 4. Topsoil: Before delivery of topsoil, furnish Contracting Officer with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past 2 years.
  - 5. Trees, Shrubs and Plants: Provide trees, shrubs, and plants of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.
  - 6. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.
  - 7. Inspection: The Contracting Officer may inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. Contracting Officer retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

#### 1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and

## Division 1 Specification Sections.

## B. Plant and Material Certifications:

1. Certificates of inspection as required by governmental authorities.
2. Manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials.
3. Label data substantiating that plants, trees, shrubs and planting materials comply with specified requirements.
4. Seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentages by weight, and percentages of purity, germination, and weed seed for each grass seed species.

## C. Planting Schedule: Proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with required maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

## D. Maintenance Instructions: Typewritten instructions recommending procedures to be established by Government for maintenance of landscape work for six months. Submit prior to expiration of required maintenance period(s).

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.
- B. Sod: Time delivery so that sod will be placed within 24 hours after stripping. Protect sod against drying and breaking of rolled strips.
- C. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by Contracting Officer. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.
- D. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots

moist by covering with mulch, burlap or other acceptable means of retaining moisture.

- E. Do not remove container-grown stock from containers until planting time.

## 1.6 JOB CONDITIONS

- A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Contracting Officer before planting.

## 1.7 SEQUENCING AND SCHEDULING

- A. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
  - 1. Plant or install materials during normal planting seasons for each type of plant material required.
  - 2. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion and/or acceptance.
- B. Coordination with Lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Contracting Officer. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

## 1.8 SPECIAL PROJECT WARRANTY

- A. Warranty lawns through specified lawn maintenance period, and until final acceptance.
- B. Warranty trees and shrubs through specified maintenance period, and until final acceptance.
- C. Warranty trees and shrubs, for a period of one year after date of substantial completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Government, abuse or damage by others, or

unusual phenomena or incidents which are beyond Landscape Installer's control.

- D. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs that are in doubtful condition at end of warranty period; unless, in opinion of Contracting Officer, it is advisable to extend warranty period for a full growing season. Another warranty inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement (per tree, shrub or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

## PART 2 - PRODUCTS

### 2.1 TOPSOIL

- A. Topsoil will be stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.
- B. Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

### 2.2 SOIL AMENDMENTS

- A. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.
- B. Aluminum Sulfate: Commercial grade.
- C. Peat Humus: Finely divided peat, so completely decomposed and free of fibers that its biological identity is lost. Provide in granular form, free of hard lumps and with pH range suitable for intended use.
- D. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.

- E. Superphosphate: Soluble mixture of treated minerals; 20 percent available phosphoric acid.
- F. Sand: Clean, washed sand, free of toxic materials.
- G. Perlite: Conforming to National Bureau of Standards PS 23.
- H. Vermiculite: Horticultural grade, free of toxic substances.
- I. Sawdust: Rotted sawdust, free of chips, stones, sticks, soil, or toxic substances and with 7.5 pounds of nitrogen uniformly mixed into each cubic yard of sawdust.
- J. Manure: Well rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials and containing no chemicals or ingredients harmful to plants.
- K. Mulch: Organic mulch free from deleterious materials and suitable for top dressing of trees, shrubs, or plants and consisting of one of the following:
  - 1. Shredded hardwood
  - 2. Ground or shredded bark
  - 3. Wood chips
  - 4. Pine needles
  - 5. Peanut, pecan and cocoabean shells
- L. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:
  - 1. For trees and shrubs, provide fertilizer with not less than 5 percent total nitrogen, 10 percent available phosphoric acid and 5 percent soluble potash.
  - 2. For lawns, provide fertilizer with percentage of nitrogen required to provide not less than 1 pound of actual nitrogen per 1,000 sq. ft. of lawn area and not less than 4 percent phosphoric acid and 2 percent potassium. Provide nitrogen in a form that will be available to lawn during initial period of growth; at least 50 percent of nitrogen to be organic form.

## 2.3 PLANT MATERIALS

- A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety



shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".

- B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
  - 1. Provide balled and burlapped (B&B) deciduous trees.
  - 2. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees subject to specified limitations of ANSI Z60.1 for container stock.
- C. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.
  - 1. Provide bare root deciduous shrubs, except where shown as "B&B", provide balled and burlapped shrubs.
  - 2. Provide bare root deciduous shrubs.
  - 3. Provide balled and burlapped (B&B) deciduous shrubs.
  - 4. Container grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to specified limitations for container grown stock.
- D. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well balanced form complying with requirements for other size relationships to the primary dimension shown.
  - 1. Provide balled and burlapped (B&B) evergreens.
  - 2. Container grown evergreens will be acceptable, subject to specified limitations for container grown stock.

## 2.4 GRASS MATERIALS

Grass Seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America. Provide seed mixture composed of grass species, proportions and minimum percentages of purity, germination,

and maximum percentage of weed seed, as specified.

Bermuda grass (cynodon dactylon)

## 2.5 GROUND COVER

Provide plants established and well rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size shown or listed.

## 2.6 MISCELLANEOUS LANDSCAPE MATERIALS

- A. Wood Headers and Edging: Of sizes required and following wood species.
  - 1. All Heart Redwood.
  - 2. Tidewater Red Cypress, All Heartwood.
  - 3. Western Red Cedar, All Heart.
  - 4. Southern Pine, pressure treated with water-borne preservative for ground contact use complying with AWPB LP-22.
  - 5. Provide wood stakes of the same species, 2" by 2" by 24" long and with galvanized nails for anchoring headers and edging.
- B. Anti-Erosion Mulch: Provide clean, seed-free salt hay or threshed straw of wheat, rye, oats, or barley.
- C. Anti-Desiccant: Emulsion type, film-forming agent designed to permit transpiration, but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.
- D. Plastic Sheet: Black, weather-resistant polyethylene sheeting, 0.008 inch (8-mils) thick.
- E. Filtration/Separation Fabric: Water permeable filtration fabric of fiberglass or polypropylene fabric.
- F. Wrapping: Tree-wrap shall be as detailed.
- G. Stakes and Guys: Provide stakes as detailed. Provide wire ties and guys of 2-strand, twisted, pliable galvanized iron wire, not lighter than 12 ga. with zinc-coated turnbuckles. Provide not less than 1/2 inch diameter rubber or plastic hose, cut to

required lengths and of uniform color, material, and size to protect tree trunks from damage by wires.

## PART 3 - EXECUTION

### 3.1 PREPARATION - GENERAL

Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Contracting Officer's acceptance before start of planting work. Make minor adjustments as may be required.

### 3.2 PREPARATION OF PLANTING SOIL

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
- B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- C. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.
- D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
  - 1. Prevent lime from contacting roots of acid-loving plants.
  - 2. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.

### 3.3 PREPARATION FOR PLANTING LAWNS

- A. Loosen subgrade of lawn areas to a minimum depth of 4 inches. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
  - 1. Spread top soil to minimum depth required to meet necessary lines, grades, and elevations after light rolling and natural settlement. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil.

2. Place approximately 1/2 of total amount of top soil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil.
- B. Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows: Till to a depth of not less than 6 inches. Apply soil amendments and initial fertilizers as specified. Remove high areas and fill in depressions. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.
1. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of Government's property. Do not turn existing vegetation over into soil being prepare for lawns.
  2. Allow for sod thickness in areas to be sodded.
  3. Apply specified commercial fertilizer at rates specified and thoroughly mix into upper 2 inches of topsoil. Delay application of fertilizer if lawn planting will not follow within a few days.
- C. Fine grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag lawn areas, remove ridges and fill depressions, as required to meet required grades. Limit fine grading to areas which can be planted immediately after grading.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
- E. Restore lawn areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

### 3.4 PREPARATION OF PLANTING BEDS

- A. Loosen subgrade of planting bed areas to a minimum depth of 6 inches using a culti-mulcher or similar equipment. Remove stones measuring over 1 1/2 inches in any dimension. Remove sticks, stones, rubbish, and other extraneous matter.
- B. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations required after light rolling and natural settlement. Place approximately 1/2 of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.

- C. Dig beds not less than 8 inches deep and mix with specified soil amendments and fertilizers.
- D. Remove 8 inches to 10 inches of soil and replace with prepared planting soil mixture.

### 3.5 EXCAVATION FOR TREES AND SHRUBS

- A. Excavate pits, beds, and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
  - 1. For bare root trees and shrubs, make excavations at least 12 inches wider than root spread and deep enough to allow for setting of roots on a layer of compacted backfill and with collar set at same grade level as in nursery, but 1 inch below finished grade at site. Allow for 9 inch setting layer of planting soil mixture.
  - 2. For balled and burlapped (B&B trees and shrubs), make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill: Allow for 3 inch thick setting layer of planting soil mixture.
  - 3. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.
- B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.
- C. Fill excavations for trees and shrubs with water and allow water to percolate out prior to planting.

### 3.6 PLANTING TREES AND SHRUBS

- A. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
- B. Set bare root stock on cushion of planting soil mixture. Spread roots and carefully

work backfill around roots by hand and puddle with water until backfill layers are completely saturated. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers of soil mixture above roots. Set collar 1 inch below adjacent finish landscape grades. Spread out roots without tangling or turning up to surface. Cut injured roots clean; do not break.

- C. Set container grown stock, as specified, for balled burlapped stock, except cut cans on 2 sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.
- D. Dish top of backfill to allow for mulching.
- E. Mulch pits, trenches, and planted areas. Provide not less than following thickness of mulch, and work into top of backfill and finish level with adjacent finish grades. Provide minimum 2 inches thickness of mulch.
- F. Apply anti-desiccant, using power spray, to provide an adequate film over trunks, branches, stems, twigs and foliage. If deciduous trees or shrubs are moved when in full-leaf, spray with anti-desiccant at nursery before moving and spray again 2 weeks after planting.
- G. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Contracting Officer, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.
- H. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
- I. Wrap tree trunks of 2 inches caliper and larger. Start at ground and cover trunk to height of first branches and securely attach. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures before wrapping.
- J. Guy and stake trees immediately after planting, as required.

### 3.7 SEEDING NEW LAWNS

- A. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
- B. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
- C. Sow not less than the quantity of seed required.

- D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with a fine spray.

### 3.8 PLANTING GROUND COVER

- A. Space ground cover plants as indicated or required.
- B. Space ground cover plants not more than 24 inches o.c.
- C. Dig holes large enough to allow for spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.

### 3.9 MISCELLANEOUS LANDSCAPE WORK

Install wood headers and edgings where required. Anchor with wood stakes spaced not more than 3 feet o.c., and driven at least 1 inch below top elevation of header or edging. Use 2 galvanized nails per stake to fasten headers and edging, and clinch point of each nail.

### 3.10 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain trees, shrubs, and other plants until final acceptance, but in no case, less than following period: 6 months after substantial completion of planting.
- C. Maintain trees, shrubs, and other plants by pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.
- D. Maintain lawns for not less than the period required and specified and longer if required to establish an acceptable lawn.
- E. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

### 3.11 CLEANUP AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

### 3.12 INSPECTION AND ACCEPTANCE

- A. When landscape work is completed, including maintenance, Contracting Officer will, upon request, make an inspection to determine acceptability. Landscape work may be inspected for acceptance in portions as agreeable to Contracting Officer, provided each portion of work offered for inspection is complete, including maintenance.
- B. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until reinspected by Contracting Officer and found to be acceptable. Remove rejected plants and materials promptly from project site.

END OF SECTION 02900